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ABSTRACT

Reviewing the current status of educational computing, this report makes 48 specific future policy recommendations for schools in Alberta, Canada. The first section discusses educational computing in Alberta and the other Canadian provinces and in Minnesota, Texas, and Florida. The second section describes aspects of the educational delivery system in Alberta and outlines ways computers can serve education. The third section makes recommendations for preservice and inservice teacher training; the evaluation, distribution, and development of courseware and hardware; the establishment of communication networks; and the development of peripheral equipment for handicapped students. It also makes recommendations concerning the planning, organization, and funding necessary to carry out these recommendations. The next section describes research studies that will be necessary to answer pedagogical questions about the most effective use of computers in schools. The last section summarizes conclusions and lists 11 goals to be accomplished in the next 5 years. A glossary of about 80 microcomputer terms is appended. The executive summary, which contains the recommendations and conclusions of the report but omits supporting material, is also included. (CB)

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COMPUTERS IN SCHOOLS

The Report of the Minister's Task Force on Computers in Schools

June 1983

Alberta
EDUCATION

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COMPUTERS IN SCHOOLS

REPORT of the

MINISTER'S TASK FORCE on

COMPUTERS in SCHOOLS

June, 1983

ALBERTA EDUCATION

June 8, 1983

The Honourable David King
Minister of Education
Room 319
Legislature Building
Edmonton, Alberta
T5K 2B6

Dear Mr. King:

As chairman of the Task Force on Computers in Schools, I am pleased to notify you that the work of the Task Force is completed. The major activities of the Task Force included meeting with many people, travelling to various places in Alberta and elsewhere, and holding eleven meetings for a total of 16 days.

Members of the Task Force gladly accepted the challenge of providing, what we consider, sound approaches to be explored with regard to future educational computing activities in Alberta's schools. The members worked with dedication in an atmosphere of cooperation, which permitted all issues to be fully discussed. This resulted in a total of 48 major recommendations.

Many key issues in educational computing were dealt with, some in more detail than others. Due to pressure of the limited time available to complete the report, we have not addressed every aspect of educational computing, but trust that further efforts will be made by others to deal with any outstanding items.

We have appreciated the opportunity to address such important matters and hope that our efforts are of assistance to you and others in helping Alberta's schools move ahead in this exciting and challenging field.

Yours truly,

E.W. Romaniuk, Ph.D.
Chairman, Minister's Task Force
on Computers in Schools

PREFACE

On October 23, 1981, the Honourable David King, Minister of Education, announced his intention to establish a Task Force to study the use of computers in Alberta schools. In a speech delivered to the Annual Conference of the Alberta Society for Computers in Education, Mr. King stated, "I propose that the Task Force have 12 members, to reflect the broad base of interests in the project. It will be responsible for making recommendations regarding pertinent issues. These include the organizational and instructional implications of the use of computers, and the feasibility of establishing an educational courseware development and marketing capability in Alberta. The mandate would include proposing suggestions for long range planning, and for the instructional and administrative uses of computers in Alberta schools".

The Task Force on Computers in Schools was established by Ministerial Order on November 16, 1981. It was organized during the spring of 1982, was convened July 17, 1982, and concluded its deliberations April 18, 1983. With the addition of one more representative, the Task Force was constituted with thirteen members, drawn from the public-at-large and all major reference groups in education in Alberta.

MEMBERS OF THE TASK FORCE

Gene Romaniuk, Chairman, representing Alberta's universities; is a Professor of Education and Associate Chairman of the Department of Educational Psychology, Faculty of Education, University of Alberta, Edmonton.

Jim Humphries, Deputy-Chairman, representing the post-secondary technical institutions and community colleges; is the Program Head of the Microcomputer Management Program, Grant MacEwan Community College, Edmonton.

George Bevan, representing Alberta Education; is the Director of the Curriculum Branch, Alberta Education, Edmonton.

Bev Brooker, representing the public-at-large; is the President of B.W. Brooker Engineering Limited, Edmonton.

Caroline Brown, representing the public-at-large; is the editor of the Alberta Federation of Home and School Associations' Newsletter, Calgary.

Alvin Gross, representing the Alberta School Trustees Association; is a member of the Board of Education, County of Barrhead, Barrhead.

Herb Hallworth, representing the Alberta chapter of the Association for Educational Data Systems; is a Professor of Education, and Co-ordinator of the Computer Applications Unit, Faculty of Education, University of Calgary, Calgary.

Darvin Heinemann, representing the computer technology industry; is President of QRD Systems Consulting Limited, Edmonton.

Max Lindstrand, representing the Alberta Teachers' Association; is Vice-Principal of Camrose Composite High School, Camrose.

Larry Naidoo, representing the Conference of Alberta School Superintendents; is the Superintendent of Schools, Spirit River School Division #47, Spirit River.

Jim Thiessen, representing Alberta Education; is the Director of the Computer Technology Project, Alberta Education, Edmonton.

John Travers, representing the Department of Advanced Education; is an Educational Technologist in the Learning Systems Branch, Alberta Advanced Education, Edmonton.

Alison Vaness, representing the Curriculum Policies Committee; is a school trustee with the Calgary Board of Education, Calgary.

TERMS OF REFERENCE

The Task Force was directed to review educational computing issues and make recommendations to assist the Minister of Education in forming policies and programs for the province. Specifically the terms of reference stated that:

> ... the Task Force shall have responsibility for reviewing problems and challenges, and for making recommendations to the Minister related to the following:
>
> 1. instructional implications of the use of computers in the province and in Alberta schools;
> 2. organizational implications of the use of computers in the province and in Alberta schools;
> 3. research studies that should be conducted relative to (a) and (b) above;
> 4. advisability and feasibility of establishing an educational courseware development capability within Alberta, including the best method(s) of setting up such a capability; costs associated with each method; courseware standards that should be established; and legal ramifications related to courseware development(e.g., copyright);
> 5. policies and practices re: introduction of computer hardware;
> 6. where Alberta schools should "be" in 3 to 5 years with respect to computers, and;
> 7. such other matters as the Minister may refer to it from time to time.

ACKNOWLEDGEMENTS

The Task Force would like to especially acknowledge and thank Michael Ede, from Alberta Education, for his assistance in the production of this report. Michael assisted in the literature review, microcomputer survey, report writing, special meetings, verification of the report with individual members of the Task Force, and other associated activities. His efforts were instrumental in the production of this report.

During the last 11 months the Task Force visited a number of schools, institutions, and agencies and held discussions with many groups and individuals. The Task Force would like to thank the following for their cooperation in assisting us in our work.

Locations	Site/Person(s)
Calgary:	• Colonel Irvine School
	• Colonel Saunders School
	• "Computers West" Project team at Jerry Potts School
	• John Diefenbaker High School
	• Southern Alberta Institute of Technology
	• University Elementary School
	• Vocational Rehabilitation Research Institute
Edmonton:	• ACCESS
	• M.E. Lazerte Composite High School
	• McNally Composite High School
	• University of Alberta
	• Westlawn Junior High School

Minnesota:

- Eisenhower High School
- Hopkins School District
- Minnesota Educational Computing Consortium
- North High School
- West Junior High School

Texas:

- Carrollton-Farmers Branch Independent School District
- Dallas Independent School District
- Houston Independent School Disitrict
- Region 10 Education Service Center
- Texas Education Agency
- University of Texas

California:

- Apple Corporation
- Computer Curriculum Corporation
- Cromemco Limited
- Lawrence Hall of Science, University of California, Berkeley
- Mendocino County Schools
- Mission Community College, Santa Clara
- Napa County Schools
- Far West Regional Educational Lab

Acknowledgements

Guests:

- Honourable D. King, Alberta Minister of Education, Alberta.
- Dr. S. Hunka, University of Alberta
- Dr. R. Lawson, Dean, Faculty of Education, University of Calgary
- Dr. E. Mokosch, Dean, Faculty of Education, University of Lethbridge
- Ms. S. Mott, Alberta Education
- Mr. R. Pawloff, Red Deer Public School District
- Dr. M. Petruk, University of Alberta
- Mr. D. Wighton, Alberta Education
- Dr. W. Worth, Dean, Faculty of Education, University of Alberta

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Submissions:

- Alberta Educational Communications Corporation (ACCESS)
- Alberta Education (Computer Technology Project)
- Calgary Public School Board
- Edmonton Public School Board
- Yellowhead School District #12

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I. INTRODUCTION

This report is concerned with the children of Alberta and the responsibility that we all share in helping them to prepare for rewarding and productive lives.

The members of this Task Force believe that the students in Alberta's schools must have opportunities to learn about computers and how to use them. Everyone will need this knowledge and these skills in the future, in their work and in their personal lives. Furthermore, the understanding of and the ability to use technology is a prerequisite to long-term economic prosperity for Alberta.

This Task Force was asked to review the use of computers in Alberta's schools over the next three to five years. With this in mind, a series of recommendations were produced which chart a direction we suggest should be followed. We feel that these recommendations will help educators maintain and improve the quality of education, while adapting to changing economic and social conditions.

This Task Force wants computers put to work in Alberta's schools, as aids to learning, instruction, and administration. We are excited by the potential of educational computing. Computers can be used to support and stimulate student learning, and can be used by teachers to improve the quality of education.

To be successful, the educational computing enterprise needs leadership at all levels, carefully developed plans, and sizeable amounts of money. Judging from the number and extent of local activities, there is obvious leadership potential that can be developed with appropriate support. With further experience and advanced training, planning capabilities can be strengthened and extended. However, progress depends upon funding support. We feel that investment in educational computing will yield direct benefits to the children of Alberta, to the province and to the country. It is an investment in people and in the future. Investing in human resources is of fundamental importance for humans alone are dynamic and have the capacity to create.

We feel that this endeavour deserves the attention of all Albertans, and would benefit from their support. Across the province, many people are enthusiastic and keenly interested in this subject. We want our education system to do more than keep in step with this interest - we expect educators to be leaders in adopting and adapting innovations of computers to the learning needs of students.

Our discussion of educational computing has been guided by an abiding concern for our children and their future. Every recommendation that we have made recognizes our shared responsibility to prepare the children of Alberta for a future which will be significantly different from the present. Much of the well-being of future generations and prosperity of our province depends upon this preparation.

We are on the verge of technical, economic, and educational change of an order not seen before. The question is not whether we can afford the effort and cost required to introduce computers into our schools. Rather, the question is whether we can afford NOT to do so.

A. OVERVIEW

This report is addressed to those interested in the use of computers in schools. It is written in language that is meant to be easily understood, whether or not one has a background in computers or in education. A glossary is attached for the clarification of a number of computer-related terms.

The first section of the report briefly reviews the current status of educational computing in Alberta and in the other Canadian provinces. This section also includes a summary of the observations of the Task Force members who visited three American states.

The second section describes certain aspects of the delivery of education in Alberta and outlines ways in which computers can serve education.

The third section sets out the specific issues which were identified and the related recommendations that have been agreed upon.

Teacher training is addressed at four levels. Pre-service (university undergraduate) programs are needed to ensure that all future teachers attain some standard of competence in the field and that those interested are able to pursue a specialization in educational computing. Inservice courses (those offered to active teachers) are necessary to provide all practising teachers with an opportunity to learn about computers. Graduate studies are required to develop leaders for this growing field. And continuing education is needed to provide a variety of courses to teachers, administrators and the public.

The need to find, evaluate, develop and purchase quality software/courseware is of primary importance. It is essential that adequate courseware for Computer Assisted Instruction (CAI), Computer Managed Instruction (CMI), and computer literacy applications be made available as soon as possible.

Progress also depends on the availability of suitable hardware. Of course, the computer revolution has just begun, particularly in education. We anticipate rapid change as computers become more accessible to schools.

In view of the complexity and magnitude of these issues, it is evident that children in this province will benefit fully from the use of computers only if Alberta Education provides decisive leadership that is supported by bold and imaginative plans. Plans should be carried forward with a commitment that recognizes the potential of educational computing and the urgent need for action. The plans will also require significant financial support. As detailed in the Funding section, support in the order of $10 million per year over the next five years is a realistic estimate of the total costs of this enterprise.

These plans should be produced in cooperation with other government departments, with the teachers of the province, with the Faculties of Education, and with reference groups that have a direct interest in public Education. Appropriate structures must be established to ensure the continuity of these endeavours.

B. Computers and Society

Our world is at the threshold of a new era. We are in transition from an industrial age to a post-industrial, high-technology age that will require us to redefine our notions of work, social interaction, progress, and achievement. The momentum behind this transformation is being generated by technological change. Of these advances in technology, the electronic computer is perhaps the most significant development of the past forty years.

The computer [1] is regarded as one of the most powerful tools ever invented. Computers have an immense capacity to rapidly store, retrieve, integrate, and manipulate data. This power is amplified when computers are interconnected by telecommunication devices.

Computers are used to perform simple, repetitious tasks, as well as complicated work that requires precise and intricate operations. Moreover, the versatility of computers has been enhanced by the development of portable, powerful, and relatively inexpensive microcomputers. These microcomputers are extending computing into homes, classrooms, and offices, and are altering perceptions about the utility and entertainment value of computers. As a result, attitudes towards informational technologies are changing. These shifts of understanding and attitude are part of an evolution towards the so-called information society, where information is a primary commodity of exchange.

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[1] We use the term 'computer' generically throughout this report. Where the term computer is used, we include the entire range of computers, from the largest maxicomputer to the smallest microcomputer. When used in reference to student and teacher use, we refer to a student learning station; this could be either a terminal connected to a timesharing computer or a stand-alone microcomputer. See the glossary for a description of computers.

As computers become more integrated into the commercial, academic, and social domains, they will significantly affect work patterns, career plans, and leisure time. Automation is changing the nature of work in offices and factories. As more work is computerized, manual functions become less relevant while reading and manipulating symbols become more important. These changes will require individuals to adapt by learning new skills and upgrading old ones. The trends have begun. Lifelong learning, through formal and informal education, is becoming more common and necessary.

C. Computers and Schools

Rapid change will compel the education system to retrain a large percentage of the workforce. In anticipation of growing demands, students who are now in school must become computer literate. To function in and contribute to the 'post-industrial' society, school graduates will need to be familiar with computers and understand the many ways in which computers may be used.

Computer literacy is a dynamic construct that will change with time. As has been the case throughout history, this form of literacy will be a source of privilege and power for individuals and nations.

At this point in time, we would define a computer literate adult as one who has:

- a knowledge of the history of computing,
- an understanding of how computers work and how they can be programmed,
- an ability to use computers as an aid to learning and as a problem solving tool,
- a knowledge of business and industrial applications, and
- an insight into present and possible future effects of computer technology on society.

Several common terms are used to describe the use of computers as aids to learning.

1. Computer Assisted Instruction (CAI) : This is one aspect of the use of computers to assist the processes of learning and instruction. Generally, the computer maintains a dialogue with the student through use of programs written by "courseware authors". Various instructional models can be used, varying from simple drill, to testing, to sophisticated simulations and tutorials. CAI courseware which is at least two or three hours in duration often contains a number of different instructional models.

2. Computer Assisted Learning (CAL) : This term is often used interchangeably with the term CAI. However, many use the term CAL in a much more global sense. Thus, CAL could encompass CAI. CAL includes activities which require the student to initiate learning; student programming, for example, could be regarded as a CAL activity.

3. Computer Managed Learning (CML) : CML is often used interchangeably with the term Computer Managed Instruction (CMI) and refers to the use of a computer to administer tests and prescribe remedial or further instructional activities. The learning activities do not necessarily require the student to use a computer; often

the student is directed to use a variety of available learning resources. When the student completes the assigned learning activties, the student returns to the computer to take an examination. One view that has been expressed is that the computer manages the learning activities by administering and scoring tests, maintaining records, allocating the available resources, and providing grades. Generally CMI requires significantly fewer learning stations than does CAI.

4. Computer Based Education (CBE): This is a general term which is often used to describe the use of a computer in an educational environment where it is an aid to students, teachers, and administrators.

II. CURRENT STATUS

A. Alberta

In comparison with the progress educational computing has made elsewhere, educators in Alberta have generally done very well. On balance, similar levels and types of activities are being offered in schools here as are available in other leading school jurisdictions in North America.

The computer literacy courses that will be piloted in Alberta schools in the fall of 1983 will place the province at the forefront of computer literacy curricular developments. In addition, Business Education curriculum which emphasizes high technology will be introduced in the fall of 1983; word processing skills and microcomputer use will be stressed.

There is a great deal of interest at Alberta's universities in teacher training in educational computing, but there are no undergraduate programs currently available. Outside of some isolated university courses, most teacher training in computing has occured at the school jurisdiction level due to local initiative. Of course, these inservice initiatives are now supported by Alberta Education, through the Computer

Technology Branch.

Very little has been done in Alberta to develop courseware/software on a commercial scale. There have been many programs produced locally, particularly for administrative uses and individual classroom use, but no concerted effort has been made to produce full scale software/courseware.

The provincial decision to standardize on the Apple format was a sensible decision, although it was criticized when it was announced in late 1981. It helped get microcomputers into schools and was a positive step at a point in time when interest was increasing. As a result, the Alberta Education Courseware Clearinghouse has been much more effective than it otherwise might have been.

Computer Assisted Instruction programs are being offered throughout the province. These offerings are found where local teachers, principals, and superintendents have taken a particular interest in the instructional uses of computers. Further activities depend upon the identification of quality courseware and the acquisition of sufficient hardware.

The Alberta Society for Computers in Education, the

Computer Council of the Alberta Teachers' Association, and the Calgary chapter of the Association for Educational Data Systems (AEDS) are very active, and have hosted conferences, student programming competitions, workshops, and information sessions. They have achieved notable success in informing and involving their membership in numerous educational computing activities.

1. Activities of Alberta Education

In the late 1960's, a number of individuals within Alberta Education explored the potential of introducing computers into the schools of the province. Due to the very high costs of computers at that time, and the virtual absence of any instructional software, no action was taken.

During the 1970's, as universities began using computers for instructional purposes, Alberta Education funded four research studies that were designed to provide data on the potential applications of computers to education.

Hallworth and Brebner of the University of Calgary did a major review of the literature related to the applications and potential of Computer Assisted

Instruction.[2] Their research provided considerable information about educational computing and made recommendations about the implementation of CAI in Alberta.

In another study, teachers were asked how they thought computers could support them in their classroom activities. A consulting firm analyzed the teachers' perceptions of the support functions that computers could provide.

The findings suggested that teachers and authorities in the field believed computers could best be used as electronic notebooks, message centres, and record keepers. It was concluded that teachers would not use computers for support functions until more computers and software were available. [3]

In 1979, a study was funded to implement the delivery of high school mathematics by using Computer Managed Instruction (CMI).[4] Subsequent evaluation suggested that teachers and students using the system found it to be effective and useful.

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[2] Hallworth, H.J. & Brebner, A. Computer Assisted Instruction in Schools. Edmonton: Alberta Education, 1980.
[3] Brown, Alan Computer Based - Instructional Support. Edmonton, Alberta Education, 1980.
[4] A study conducted by Calgary Public School Board & SAIT.

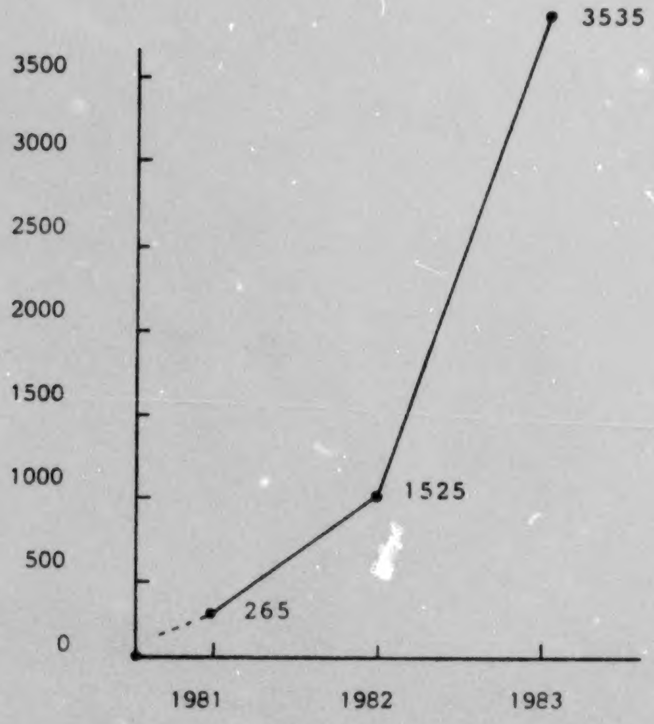
In October of 1981, the Honourable David King, Minister of Education, announced the creation of a Computer Technology Project. A provincial hardware standard, a courseware clearinghouse and a program to coordinate inservice were established. Research and evaluation funds were provided, and an Office of Educational Technology was created. In addition, a commitment was made to introduce computer literacy courses into schools.

These activities were formally initiated on April 1, 1982. The Computer Technology Project activities are proceeding as planned. One thousand Bell and Howell (Apple format) microcomputers were sold to schools through the School Book Branch.

The elementary school computer literacy curriculum has been pilot-tested during the 1982-83 school year, and will be implemented in September, 1983. Junior and senior high school computer literacy curricula are scheduled for pilot-testing in September, 1983, and for implementation in September, 1984.

2. Survey Results

To determine the use of microcomputers in Alberta schools, a questionnaire was sent to all school principals in the province during each of the past three years. The results of these three surveys are tabulated in Table I. In the two year period from the spring of 1981 to the spring of 1983, the number of microcomputers has jumped from 265 to 3535, an increase of 1245 percent.



The third survey, conducted in the Spring of 1983 yielded 1351 responses out of the 1680 questionnaires mailed to the schools.[3] As of February 1, 1983, a total of 857 (63.4%) schools had microcomputers. Of the 3535 microcomputers, there were 2077 of the Apple format, 974 Commodore, 181 Radio Shack and 303 'others'. Of the 499 schools in Calgary and Edmonton that responded, 63.3% had one or more computers. The total number of microcomputers in Calgary and Edmonton schools is 1532, or 43% of the total. This is consistent with the Calgary and Edmonton student population, which is 40.5% of the provincial total. These figures illustrate the increase in the numbers of microcomputers in Alberta schools. Many of the schools without computers are smaller, rural elementary schools.

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[3] Petruk, M. & Ede, M. 1983 Alberta Microcomputer Survey. Edmonton: Alberta Education.

B. Canada

The ministries of education of most of the other provinces in Canada have initiated programs to introduce computers into their schools. In particular, Quebec and Ontario have made major decisions to assist school jurisdictions in the acquisition of computer hardware.

Other provinces are reviewing their priorities and investigating alternatives before setting courses of action. Judging by the planning and programs that are now underway, many educators in all parts of the country are enthusiastic about educational computing. Table 2, provides recent estimates of the number of microcomputers in the schools of each of the provinces. While the number of microcomputers in a province does not indicate the nature or level of activities, it should offer an indication of the extent of activity.

Table 2. Estimates of Microcomputers in Canadian Schools
(As of April 1, 1983)

PROVINCE	STUDENTS	MICROS
British Columbia	520,000	2,500
Alberta	440,000	3,535
Saskatchewan	200,000	1,500
Manitoba	200,000	1,610
Ontario	2,000,000	8,000
Quebec*	1,037,000	800
New Brunswick	125,000	1,000
Nova Scotia	180,000	800
P.E.I.	25,000	150
Newfoundland	135,000	200

* Does not include CEGEP'S (junior colleges)

Within the past two months, Ontario and Quebec have both made major commitments to educational computing. In late March, the Ontario Ministry of Education announced that it had entered into a contract to purchase $10 million worth of microcomputer equipment from the Canadian Educational Microprocessor Corporation (CEMCorp) for distribution to Ontario school boards. These systems will be made available to school boards at 25% of the manufacturer's contracted price. CEMCorp is a government assisted consortium of companies, primarily located in Ontario, that plans to design and manufacture microcomputer systems specifically for the Canadian education market. The systems to be developed will be consistent with the Ministry's functional requirements for "Standard", and "Advanced" Student Microcomputers, which were released in March of this year.[4] Of the funds allocated, $2 million will be used to develop and test prototype systems in Ontario's schools, beginning in the fall of 1983. CEMCorp had experienced difficulties in 1982, but appears to have been reorganized and revitalized.

Ontario has also chosen to invest considerable money and effort in encouraging the growth of an educational software industry in the province to produce courseware compatible with the CEMCorp microcomputer. Through the provincial Board of Industrial Leadership and Development, $1.3 million for 1983 have been allocated to set up an advisory body to identify and assign a priority to educational software needs and to initiate other activities. Funds of $5.46 million in 1984, increasing to $10 million in 1986, will be used to provide developmental grants to producers and to purchase licenses from producers to allow unrestricted use of materials within Ontario.

---

[4] The hardware standards that have been established include a "Standard Student Microcomputer", based on a 16-bit electronic architecture with 128k of random access memory (RAM) that can be expanded to 256k. The "Advanced Student Microcomputer" is based on a 32-bit electronic architecture with 256k of RAM, expandable to 1024k. In addition, the systems will include a control storage facility called "Fileserver", containing a floppy and hard disc drive, with 256k of RAM, local area network interfaces, and specified high resolution colour and monochrome video display terminals. A voice synthesizer and tone generator, a text processor, a Telidon graphics package and seven programming languages are also specified.

In Quebec, the Minister of Education recently announced plans to invest $150 million over the next five years to place microcomputers in classrooms and to produce high quality software written in French. Approximately 32,450 microcomputers are to be acquired--16,000 for primary schools, 9,600 for high schools, 2,850 in the CEGEP's (colleges) and 4,000 in the universities. The province is following a "Buy Quebec" policy and will negotiate framework contracts with hardware manufacturers already in the province. Some observers predict the province will choose one vendor, and will emphasize the use of communications networks.[7] It is expected that contracts will be let in the near future for the development of French courseware.

Other provinces have also been very active. British Columbia was one of the first provinces to officially support microcomputers in its schools. In 1979, the Ministry of Education placed approximately 100 Apple microcomputers in 12 pilot projects, and initiated a number of pioneering research efforts through JEM (Joint Educational Management)

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[7] Computing Canada, April 14, 1983, pp. 1,2.

Research, a not-for-profit, Victoria-based, educational research agency.

British Columbia, along with Alberta, Ontario, Nova Scotia, and New Brunswick helped fund a survey by JEM Research to review the cataloguing and indexing of microcomputer courseware. In addition, British Columbia, Alberta, and Manitoba plan to cooperate in courseware evaluation in an effort to spread the workload.

Saskatchewan has been active for several years in supporting school jurisdictions; for example, they have distributed a series of information bulletins. Saskcomp, a provincial crown corporation, has chosen the Apple microcomputer format as a standard and sells compatible products for school use.

The Manitoba Department of Education has operated a province-wide high school computer network for some time. The telecommunications, hardware, software, and computing costs are shared by the participating school jurisdictions and the Manitoba Department of Education. In addition, a consortium consisting of a number of school jurisdictions and the Department of Education has developed a series of computer-based instructional programs for children and adolescents. Manitoba has been one of several sites for Telidon field trials.

An Advisory Committee on Computers in Education reported to the Manitoba Minister of Education in May, 1982. One of the recommendations was that there be "... strongly guided local development, the maintenance of needed control services, and a delay in any decision regarding the expansion of central services."

New Brunswick appointed a Coordinator of Computers in Schools in late 1981. The coordinator's job is to help improve the understanding of educational computing in the province's schools, to arrange for provincial hardware purchase agreements, and to assist in the search for quality courseware.

In Nova Scotia, Prince Edward Island and Newfoundland, there are a number of local activities in progress, but the provincial governments have not initiated major educational programs. There is considerable interest and the respective ministries are monitoring developments prior to making decisions.

C. United States

Late in 1982, three sub-groups of the Task Force travelled to Minnesota, Texas, and California, to meet with educators and others in order to become familiar with progress and development in these states.

1. Minnesota

G. Bevan, D. Heinemann, and L. Naidoo travelled to Minnesota in early December to visit school districts and attend the Annual Minnesota Educational Computer Consortium (MECC) Conference.

During the past decade, Minnesota has been at the forefront of educational computing in the United States. The state was one of the first to plan the introduction of computers into the school system.

In 1973, MECC was established, to coordinate and support the educational computing activities of the approximately 450 school districts in the state. In this effort, it is assisted by the universities and the state Department of Education. Originally, MECC was funded entirely by state grants, but spending restraints have reduced the level of grant support. A proportion of its revenue now comes from the sale of courseware that has been developed in Minnesota. All member school districts pay an annual fee to the consortium, for which they receive rights to all courseware developed under the auspices of MECC.

As a result of a decade of planned activity, educators in Minnesota have gained considerable experience in educational computing. However, their courseware development efforts have not been as focussed as they might have been in a different system. Minnesota does not have a common, state-wide program of studies in its schools. Consequently each school district determines its own curriculum, and its specific courseware needs. In addition, MECC relied on a mainframe computing network until two years ago when it shifted to microcomputers. Notwithstanding the progress member districts of MECC have made, they face many of the same challenges as we do - a need for good quality courseware, teacher training programs, and more hardware.

When MECC moved to microcomputers, it adopted an Apple standard. Five thousand Apple computers had been acquired by schools in the state as of December, 1982. The evaluation of different hardware brands is continuing and a 'buy-agreement' was recently negotiated with Atari. There is a recognition that there is not one 'best brand', but that some brands are better for specific applications than others.

The delivery of inservice programs varies widely, from voluntary, informal programs to well organized sequential programs. Some districts offer salary and other incentives to encourage teacher participation in the inservice programs. Several educators stated that the concept of computer literacy lacked real meaning - that familiarity with computers can be better described by referring to the extent of one's computer experience. Whatever the method used to measure this familiarity, there was agreement that children and teachers should have a working understanding of computers.

Minnesota has enjoyed a significant degree of success in integrating computers into the state school system. This resulted from an early decision to cooperate and support educational computing in schools, that was backed by the financial assistance of the state education authorities. The value of supporting software development by educators was recognized. MECC has actively planned and promoted software development and has marketed it widely. A differentiated standard approach to hardware acquisition has been adopted, and buy-agreements with selected hardware manufacturers have been negotiated. The strong public support for the initiatives the state has taken has reinforced the success it has achieved in educational computing.

2. Texas

Two members of the Task Force, H. Hallworth and J. Humphries, travelled to Texas in December, 1982, for a week of meetings with teachers and administrators in schools in Dallas, Austin, and Houston.

There is a wide variety of educational computing activities in Texas. However, the programs are fragmented - the level of activity depends on local leadership and the ability to obtain funding support from community, state, and federal granting schemes.

Generally, the educators in Texas appear to recognize a need to introduce computers into schools as quickly as possible. The consensus was that all students should have an opportunity to become computer literate, and that computer literacy is essential for the United States to survive in the economic competition with other countries. Indeed, a major reorganization of the Texas public shool curriculum, now underway, is likely to mandate computer literacy for all students.

Teacher education was highlighted as a key to the effective introduction of computers into schools. Teachers acknowledged that inservice programs would have to be revised and offered for many years, to keep up with progressive developments in computer languages, authoring systems, hardware and the like. There was no visible evidence of any consistent and coordinated effort to provide inservice training. Local jurisdictions were offering their own programs. In certain cases the offerings were comprehensive; for example, the Houston Independent School District offers a number of courses, primarily intended for specialists. However, it was generally accepted that the existing inservice offerings are not sufficient to train the 200,000 teachers in Texas.

The pre-service programs for teacher training are similar to those offered in Alberta, in terms of the date of inception, the programs offered, and the type and number of courses. The most notable programs are offered at the graduate level at the North Texas State University and the Universities of Texas and Houston. The other teacher training institutions in the state have apparently not progressed as far in their program offering as have the three Faculties of Education in Alberta.

Computer Assisted Instruction in Texas, has for the most part been delivered via terminals. However, there is a widespread expectation that CAI will be delivered primarily by microcomputers, and will become more prevalent in the future. For example, the Region 10 Education Service Center in Richardson is planning to introduce CAI into all schools for all students.

There is some activity in courseware development in the larger urban school districts. A number of people felt it was appropriate for the Texas Education Agency to help develop needed courseware which is not commercially available.

There is considerable activity in Computer Managed Instruction (CMI) in Texas, perhaps due to the interest in accountability and mastery learning in education in the United States. CMI applications observed relate primarily to student evaluation.

There is no standardization of computing hardware in Texas. The trend is clearly towards microcomputers - the approach is to acquire any microcomputers that can perform a task effectively and at a reasonable cost.

There was an exciting variety of computer activities in the schools of Texas and a firm sense of commitment to the endeavour.

3. California

Three members of the Task Force, A. Gross, M. Lindstrand and J. Travers, travelled to California for a week in December and met with teachers, administrators and computer company staff.

California is recognized as the centre of research and development in micro-electronic technology in the United States. Within the state, there is a significant contrast between the bustling activity of the private sector and the state funded school system, which is retracting as a consequence of the financial restraints imposed by state tax revolts and reduced federal funding.

There were some evident aspects that characterized the approach to educational computing in California. Every successful program observed was the result of strong local leadership. Very little has been done to offer pre-service educational computing courses to teachers, and apparently nothing is being planned for state-wide applications.

Hardware decisions were made on the basis of the suitability of the microcomputer for the application cited.

Microcomputers of the same brand were usually grouped in classroom sets for the delivery of instruction. The consensus was that no more than two students per terminal is practical for CAI purposes.

Some of the administrators indicated that a total curriculum revision is required in California to make courses relevant. If not, computers might be used to perpetuate an antiquated curriculum.

A team of consultants who work with individual school districts indicated that school districts should first define their interests and determine what expertise is available. They should then establish a Computer Utilization Committee to set goals and set priorities. The next step is to create a Computer Acquisitions Committee to set standards, deal with vendors and aggressively negotiate buy-agreements for microcomputers that have been chosen on the basis of application. Incentives should be used to encourage teachers to produce courseware. School districts can approach staff training by first scanning their system to identify capable teachers; these knowledgeable teachers can then offer initial awareness courses in the district's schools. Computer awareness courses generally run between 10 and 40 hours in length. There seemed to be no state-wide inservice effort, but it was generally accepted that inservice programs could be offered locally using the resident expertise.

In meetings with administrators and manufacturers, the use of networks, such as the Apple "School Bus", a classroom and local area networking system was discussed. This allows a teacher to "download" programs to one or all of the microcomputers in a configuration, and gives the teacher access to unique files.

Some teachers argued for the teaching of programming because it helps students to think using logical, sequential thought; to communicate tasks to others; and to meet their individual needs while helping determine the capabilities of computers.

Through strong commitment and innovative approaches, California educators have made considerable progress in using computers in their schools. Perhaps the single most important factor in achieving some success has been local individual leadership.

III. EDUCATION IN ALBERTA

How can educators use computers to improve the quality of the education that is provided to the students in Alberta's schools?

This question set the context for the discussion by Task Force members of issues in educational computing. To answer this question, it was concluded that it would be useful to comment briefly on the purposes of education and refer to certain features that have characterized the province's school system. Following this overview is an outline of some of the ways in which computers can serve the process of education.

A. Education - Past and Present

There has been some debate about the distinction between "education" and "schooling". Education can be described as a lifelong process of learning - of adding to personal knowledge, and skills. Schooling, as a formalized aspect of education, is a process which is defined in part by its duration, usually during pre-adult years, and the location where it is offered, usually a 'school'.

To preserve their culture, individuals within a society identify desirable skills, knowledge and characteristics and develop a system of education to ensure that children acquire these qualities. The formal system of education currently focusses more on the development of skills and the acquisition of specific knowledge as the roles of individuals become more specialized and complex.

The formal, publicly supported school system in Alberta provides instruction that is consistent with a provincially mandated program of studies. All students in the province from the ages of six years through fifteen years receive schooling that is intended to be universally available, equally accessible, and essentially free of charge.

Underlying our system of education are the notions that each individual is unique, valuable and dynamic, has the right to be treated with dignity and respect, and is responsible for making a positive contribution to society. These notions are subsumed by the provincial statement on the 'Goals of Basic Education for Alberta'*

Considerable attention is paid to the individual differences of students in the existing school system. This system evolved from a model that developed in the United States and Western Europe in response to the demands of the industrial age, late in the last century. People needed to acquire basic literacy skills and new forms of knowledge to function within society. A system of schooling had to be created to provide a basic standard of instruction to large numbers of children. Students of certain ages were required to attend school for a specified period of time each day; they were grouped into classes, by age and ability; they progressed through school in a 'lock-step', graded fashion; and instruction was delivered primarily through lectures.

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*Adopted by the Legislature of the Province of Alberta, May 15, 1978.

This model has been refined. Teachers have long recognized the need for greater attention to the individual problems and needs of students, and their efforts have considerably improved our education system. Nonetheless, this application of the model of delivery of instruction that developed, along with the growth of industrialization, still forms the basic foundation of our education system. This model is being strained by the social changes that we are now experiencing.

Teachers are not always able to devote as much attention to individual students as they might wish. They are constrained by large numbers of students and administrative demands on their time; these are but two areas where computers can be of assistance in our schools.

B. Vision

Computers can help teachers teach, can help students learn and can perform administrative and clerical operations to assist teachers and administrators in the work they do to support instruction. The following give an indication of the ways in which computers can serve educators. They can:

1. enable us to deliver instruction more effectively. A recent review of CAI studies noted that students whose conventional instruction was supplemented by CAI learned the same amount of material more quickly, or more material in the same time.[9] [10]

2. allow us to more effectively individualize instruction. This can occur in two ways. First, with well designed CAI courseware, students can receive individual, interactive instruction directly. Second, in a classroom where CAI is being used, teachers may be able to spend more time with each individual than they otherwise would, giving the student direct attention while others are active. As has been noted:

   > ...with the present organization of learning and instruction on a classroom basis, a teacher cannot devote more than one or two minutes of personal

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[9] Hallworth, H. J. & Brebner, A. *CAI in Schools*. pp.174,175.

[10] Rapaport, P., Savard, W. G., *Computer Assisted Instruction*. Alaska Department of Education, December, 1980, pp. 10-11.

> attention per day to each student (Conant, 1973). This is the case even with the use of teacher aides. To attempt to blame the teacher for this state of affairs is pointless. The problem is not that the teachers are not teaching and, within the limits of the system, teaching well. It is simply that the students are not receiving individual attention and are therefore not learning as effectively as they could.''

3. allow us to improve the support of individualized learning. Students who are able to use computers and quality courseware will be able to progress at their own pace, at a rate determined by their own interests and abilities. They will not be constrained by the average rate of progress of their classmates, as can be the case in traditional classroom settings.

4. enhance and stimulate the problem solving and creative capabilities of children. Some children can learn computer languages, which require logical, sequential thinking and write their own programs to solve problems; most children can use simulations to more clearly understand processes which are difficult to comprehend. Some young children can use utility programs, such as word processing programs to write and thereby express themselves more freely than they could by manual means.

''Hallworth, M. J., Brebner, A., Productivity in Education: A Case Study. CIPS Review, March/April, 1982, p. 20.

5. enable teachers to spend their time more effectively. If computers are used for administrative work, such as record keeping, exam scoring, test item banking and monitoring student progress, teachers can reduce their work loads. If they are less constrained by time-consuming, routine chores of classroom management, teachers can devote more of their time to individual students.

6. aid in the establishment of interactive computer networks which may be used to improve planning, information transfer and control, administration, and student assessment.

7. be used to provide career counselling and guidance assistance to students.

8. assist in providing training experiences relating to the world of work.

9. provide leisure time activities.

These are some of the ways in which computers can be used in our schools. The recommendations that follow are the components of an approach which will enable Alberta's students and teachers to make extensive use of computers.

IV. ISSUES AND RECOMMENDATIONS

A. STUDENTS AND CURRICULUM

Issue:

The Task Force recognizes the necessity of providing students in Alberta with an opportunity to use computers. We want to ensure first that all students have this opportunity. In addition, we have concluded that the course of studies of the province must be adapted to accomodate computers and allow students and teachers to better realize the educational potential which computers offer.

Recommendation #1:

That by 1985 all students in Alberta schools shall have regular access to a computer learning station.

Comments:

Regular access to a computer learning station is necessary if our school graduates are to become computer literate.

By "regular access" we mean direct, organized and reliable computer access. We suggest that students have daily access; the actual scheduling will vary according to a student's timetable and the program in which the computer is being used.

Computer literacy was identified as a primary objective which can be attained in the forseeable future. Any definition of computer literacy should be dynamic, and open to revision. As time passes, we expect individual students will progress beyond the level we now describe as computer literacy, to more challenging and productive uses of computers.

As mentioned earlier, major societal changes are fragmenting conventional career plans and are reshaping occupational patterns. These changes require schools to offer instruction in new skills and to facilitate the acquisition of knowledge that will be required in the future. Students must be comfortable with and understand how to use computers. If not, they may find that they lack the basic skills needed in their daily lives. We feel that universal and free access to computers will be as much a part of the schooling of tomorrow, as access to text books and libraries is today. With this prospect in mind, we endorse Alberta Education's introduction of computer literacy courses at the elementary, junior high and senior high levels.

Recommendation #2:

That the Minister of Education initiate a review of the Program of Studies to:

- introduce components related to technology and its current and future impact on society.
- adapt the sequence, structure, and design of the Program of Studies to accommodate continuous student progress and to encourage a personalized, self-directed learning approach.
- modify the content of appropriate courses to allow for the use of computers in ways that will stimulate the problem solving and creative abilities of students.

Comments:

The review proposed by this recommendation has far reaching implications and will require significant effort and commitment. However if computers are to make a meaningful contribution to the formal process of education, this effort is necessary.

The purpose of the review is, in part, to increase student understanding of the significance of computers and high technology to their lives and to society. In addition, this review would investigate the best methods of integrating the capabilities of educational computing with the curriculum taught in our schools. The review should be initiated quickly to ensure that the full potential of computers is realized as soon as possible.

Another aspect of this revision relates to the introduction of a computing science program. We recognize that computing science is a broadly based and expanding field of study. To assist in providing computer courses to as many students as possible, we believe that serious consideration should be given to establishing a Computer Science program, at the high school level, that is apart from any existing department (e.g., Science, Business Education or Mathematics).

B. TEACHER TRAINING

Issue:

Generally speaking, the success or failure of any innovation in education depends upon the positive reception and application of the innovation by classroom teachers. This is particularly true in the case of computers. The Task Force concluded that it is of utmost importance that the training of teachers in educational computing not be neglected.

Many teachers are enthusiastic about computers, and have invested considerable time and energy in learning how to use them. The leadership shown by teachers is currently providing much of the momentum and excitement in this field. However, it is estimated than only 6% of the 27,000 active teachers in Alberta have a working knowledge of computers and are acquainted with their different applications. Obviously, when a majority of teachers become knowledgeable about computers and comfortable with their use, this innovation will make a more meaningful contribution to education.

For the purpose of this report, the issues of teacher training have been subdivided into four categories which describe the types of courses teachers may pursue:

- preservice or university undergraduate courses offered to prospective teachers,

- graduate degree programs at university,
- inservice courses offered by various agencies to practising teachers, and
- continuing education courses.

1. Preservice

Recommendation #3:

That all students graduating from the Faculties of Education of Alberta's Universities after July, 1986, be required to have completed a computer literacy course.

Comments:

We suggest that the three Faculties of Education cooperate in developing a standard 3 credit (40 hour) computer literacy course that would include:

1. an understanding of the significance of computers to society, with particular reference to their social, cultural, and commercial implications.
2. an introduction to Computer Assisted Instruction and Computer Managed Instruction, reinforced by practical and classroom experience.
3. an introduction to a common computer language, to programming, to the problem solving capabilities of computers, and use of a computer in these areas.
4. an introduction to courseware evaluation.

Recommendation #4:

That the Board of Teacher Education and Certification prescribe the successful completion of a one semester computer literacy course as one of the prerequisites for graduation from an undergraduate program in a Faculty of Education in Alberta.

Comments:

This is necessary to ensure that the pre-service literacy course is introduced.

Recommendation #5:

That the Board of Teacher Education and Certification establish the successful completion of a standard, 40 hour computer literacy course as a requirement for the certification of teachers coming into Alberta.

Comments:

We suggest that the Board of Teacher Education and Certification consider granting a two year interim certificate to teachers coming to Alberta who have not previously taken an equivalent course in educational computing. During this period these teachers would be expected to complete a standard computer literacy course.

Recommendation #6:

That the Faculties of Education in Alberta's universities offer major and minor specializations in educational computing.

Comments:

We feel that it is essential to offer training at the undergraduate level to allow prospective teachers an opportunity to specialize in this important field. Initially these specializations could include Instructional Applications of Computers, Computer Science, Business Education, and Industrial and Vocational Education.

2. Graduate Training

Recommendation #7:

That graduate programs in educational computing be offered by the Faculties of Education in Alberta Universities.

Comments:

Graduates from these programs should be knowledgeable about computer hardware, software development and programming, and should be thoroughly familiar with the uses of computers in schools. It is expected that these specialists will teach other teachers about educational computing, will be able to design courseware, and will promote the use of computers in schools. The energy and leadership of these specialists is crucial to the success of this endeavor.

There is a small number of teachers who have taught themselves a considerable amount about educational computing. We suggest that the Faculties of Education give consideration to teachers enrolling in graduate courses who have independently attained certain levels of competence.

Both the Universities of Alberta and Calgary have had graduate offerings in educational computing for some time. These programs would need to be significantly increased to meet the anticipated demands.

Recommendation #8:

That Alberta Education provide financial incentives to enable practising teachers to undertake graduate training in educational computing.

Comments:

As we have noted, leadership is of vital importance in a developing field such as this. Many practising teachers can not pursue graduate studies on a full-time basis without financial assistance. Due to the the pressing need for specialists, it is important that teachers have opportunities to undertake graduate programs on a full-time basis.

We recommend that Alberta Education offer bursaries of not less than $12,000 per annum which could be supplemented by funds, or other incentives, from the teacher's school jurisdiction. These bursaries should be awarded annually and should fund a minimum of one teacher from each school jurisdiction in the province.

In return for the support received from their sponsoring school jurisdictions, teachers would undertake a return service commitment. This return time might be best spent advising other teachers in their jurisdiction about educational computing - hardware placement, the design, development and evaluation of courseware, and implementation strategies. There may be a number of teachers who would be interested in a post-graduate degree in this field, but are unable to study full-time. Therefore, universities should be encouraged to review their graduate degree residency requirements to permit part-time students to enroll in these programs. A number of quality graduate students have enrolled in programs at universities outside of Alberta, primarily due to the relaxed residency requirements at other universities.

3. Inservice

Recommendation #9:

That an inservice program be developed and funded by Alberta Education, local jurisdictions, and the teaching profession to offer every practising teacher and educational administrator in Alberta the opportunity to learn the fundamentals of educational computing. Further, that implementation of an inservice program begin before the end of the 1983-1984 school year.

Comments:

There is a pressing need to introduce all practising teachers in this province to educational computing. A recent nation-wide review found virtually unanimous agreement that teachers and administrators should receive, at least, an introduction to educational computing applications.[12] Currently, a number of school jurisdictions in Alberta are offering short, introductory in-service courses to their teachers. This initiative is commendable, but more enduring results can come from long term, ongoing inservice programs, that have been adapted to fit local needs.

There are three levels of proficiency:

1. an awareness of what computers can do,
2. an ability to use computers effectively, and
3. an ability to write programs and to teach about the use of the computer.

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[12] Muir, W. & Forman, D. Computers in Education and the Inservice Needs of Canadian Educators. Victoria, 1982.

Initially, the goal should be to enhance the computer awareness of every teacher in the province.

The primary objective is to offer programs that will enable all interested teachers to become confident in their ability to use available computer hardware and software. This second level of proficiency should be attained by as many teachers as are interested, as soon as possible. The third level of proficiency is best attained through continuing education courses, and graduate degree programs.

Inservice in educational computing is unlike any other inservice program because of the number of teachers that must be reached and the number of dimensions involved. These include hardware, software, instructional design, programming and applications. In addition, there is a need for different programs for administrators and trustees. As noted in a recent national review, administrators need to be informed of the time and costs involved in providing computing facilities, the range of hardware and courseware available and the inservice needs of the teaching staff in their jurisdictions.[13] Trustees need to have a reasonable understanding of the social and economic impact of computers on society, understand how the devices can be used in schools and be aware of the costs of introducing them.

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[13] *op. cit.*, Muir, W., Forman, D., p. 4 The Inservice Needs of Canadian Educators, report prepared by JEM research for Council of Ministers of Education, Canada, Victoria, December, 1982, p. 2.

The responsibility for delivering inservice programs is best left with local jurisdictions. The content and support of the program is best developed by the cooperation of Alberta Education, the Alberta Teachers Association, Alberta School Trustees Association, and the local school jurisdictions and their teachers.

Having observed several inservice program models, we recognize how important it is to have access to computer hardware. There is also need for good quality printed resource material to support any inservice program.

Intensive one day workshops, which could be sponsored in part by vendors of computer hardware, may be adequate for introductory computer awareness sessions. These can be, and often have been, conducted during professional development days. Computer awareness can also be delivered by television or videotape with the assistance of ACCESS.

Any serious inservice course must provide hands-on experience. In our view, effective introductory inservice requires about one week of time to allow teachers sufficient opportunities to work directly with computers under the direction of skilled instructors. This inservice program could be offered in a single block of time, or offered over a period of time, allowing teachers a chance to practice between sessions. If this is to be offered during the school year, it will incur costs for release time, travel and equipment.

4. Continuing Education

Recommendation #10:

That post secondary institutions and other agencies, such as further education councils, offer credit and non-credit courses in educational computing to teachers and interested members of the public.

Comments:

Continuing education courses are intended for three different audiences. The first is teachers, who take these courses to upgrade their skills and knowledge. The second is the general public, particularly parents, who are motivated to understand what their children are doing. The third are students who want to undertake various sorts of courses, such as those offered at computer camps, to pursue their special interests.

We encourage school boards, post-secondary institutions and other agencies to offer these courses. In particular, we hope that school trustees and teachers will invite parents to participate in courses, as a knowledgeable and involved public is crucial to the success of any school program.

C. COURSEWARE

Issue:

Software is a program or collection of programs which cause computers to perform certain functions. Courseware relies on software programming to offer the user a computer program with educational content and an emphasis on instruction. It can contain ancillary off-line print and audio/visual materials. These terms are often used interchangeably.

The availability of quality courseware directly influences the rate of progress of instructional computing. The content and design of software determines the quality of the computing endeavour. We define quality courseware as instructionally and technically sound, 'user friendly', interactive computer programs; moreover, for use in Alberta, quality courseware must be consistent with the Alberta Program of Studies. Quality CAI courseware maximizes the potential of computers to offer individualized instruction.

At present, there is a very limited amount of quality courseware on the market - particularly, courseware that is consistent with the Alberta Program of Studies. For instance, the Computer Technology Project of Alberta Education has been evaluating mathematics courseware since September of 1982, and has rejected approximately 90% of the courseware tested - in most cases because of instructional deficiencies. To be fair, it must be noted that the Curriculum Branch also rejects a very high proportion of the written texts that it screens. Quality learning resources are not easy to find.

The production of CAI courseware is an expensive and time consuming task, primarily because the production of courseware and programming is labour intensive. One estimate is that 300-600 hours of time is needed to develop one hour of sophisticated courseware;[14] while another, based on the experience of the Plato Project suggests 30 hours as a reasonable guideline for less sophisticated courseware.[15] Cost estimates range widely, but it has been suggested that $2000 per hour of courseware is a minimum.[16]

We believe that the provincial government should assist in the development of a strong and competitive software industry in Alberta. This industry is labour-intensive, and future oriented; its products can be marketed outside the province and easily distributed. Such an industry is consistent with the provincial economic diversification strategy. A thriving software development industry in Alberta, encouraged by the government through incentives and other means, would clearly assist the province in achieving its educational objectives.

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[14] Fouley, The Future of CAI, Saskatchewan.

[15] *op. cit.* Hallworth, H. J.; Brebner, Computer Assisted Instruction in Schools p. 214.

[16] Ragsdale, Computers in Schools - A Guide for Planning, OISE, Toronto, 1982, p. 25.

1. Standards/Evaluation

Recommendation #11:

That Alberta Education continue and expand its work in courseware evaluation by further defining and disseminating content, instructional format, and technical design standards.

Comments:

The courseware evaluation operation of the Alberta Education Computer Technology Project has been active for eight months. The evaluation procedure is summarized in the April, 1983, Computer Courseware Evaluation reports as follows:

> "Alberta Education has set up a three stage process for the evaluation of computer courseware. Materials are first screened by the Clearinghouse. If found appropriate, the courseware is evaluated independently by three teachers who have been trained in evaluation techniques and the use of the instrument used by Alberta Education. Their three reports are synthesized into one report, and if that report is favourable, the materials advance to the final stage. In the third stage, the courseware is assessed by a Curriculum Committee which makes a recommendation as to the status of the materials.
>
> Courseware may be designated as a "Prescribed", "Recommended" or "Supplementary" learning resource (see glossary). The Curriculum Committee may also choose not to make any designation.
>
> Materials which are designated as "Prescribed" or "Recommended" are acquired by the School Book Branch and made available to the schools. "Supplementary" materials are not purchased but information on cost and source is made available to the schools."

We recommend that these courseware evaluation activities be expanded to as many subject areas as manpower permits. We advise that the content, instructional format and technical design standards that have been established, or are in the process of being defined, be reviewed periodically (preferably on an annual basis) in accordance with hardware improvements, changes in curricula, and the evolving understanding of courseware design.

This upgrading of courseware standards is intended to ensure that the quality of learning resources improves along with other developments. Previously approved courseware need not be disqualified - market forces will determine acceptance.

These standards should be widely distributed so that they are known to courseware developers who seek endorsement of their products by Alberta Education.

Recommendation #12:

That Alberta Education develop a capacity to evaluate educational software.

Comments:

In our reference here to software, we mean that word processing, electronic spread sheet, management systems, and the like be evaluated, in addition to courseware.

Recommendation #13:

That, where possible, Alberta Education cooperate with school jurisdictions, agencies and other provincial departments in the evaluation of courseware, and in establishing uniform standards for cataloguing and indexing, plus technical and pedagogical design.

Comments:

Because of the high costs associated with evaluating and cataloguing courseware, we encourage Alberta Education to cooperate in this endeavor with as many other agencies as is practical. Uniform standards will help to facilitate this cooperation.

Representatives of Alberta Education and others have initiated a standard cataloguing and indexing capability. We encourage this cooperative effort and the further participation of Alberta Education in projects designed to share the workload of courseware evaluation.

Recommendation #14:

That all courseware be field tested by teachers and students in Alberta's schools, prior to being designated as "prescribed" or "recommended".

Comments:

There is at present a network of experienced teachers who are evaluating the instructional design and instructional effectiveness of courseware in specific subjects. We endorse this method of evaluating courseware. The best way to determine the quality of courseware is to have teachers test it in their classes. The teachers must know the subject, be aware of the products on the market and have experience in the classroom use of computers.

Once the evaluation has been conducted, it is essential that the results be distributed widely in the province.

2. Clearinghouse/Distribution

Recommendation #15:

That Alberta Education continue to operate a central courseware clearinghouse and that all endorsed courseware meet Alberta Education's established standards.

Comments:

In some instances, province-wide distribution licenses may be purchased for material which includes individual components that do not meet established standards. These opportunities should not be overlooked if such a licence is the most practical means of acquiring a sizeable package of materials. However, the package should, on balance, meet established standards.

Recommendation #16:

That buy-agreements continue to be made with the vendors of prescribed and recommended courseware and that this courseware be distributed, where practicable, through the School Book Branch of Alberta Education at the standard discount.

Comments:

Several buy-agreements have already been concluded, one in the form of a licence that allows distribution of Minnesota Educational Computing Consortium courseware throughout the province. In addition, licences allowing direct distribution to the provincial education market but which leave the rights to other markets in the hands of the producers, can be used to encourage development of courseware/software in Alberta. This is a cost effective way of acquiring courseware for use in Alberta.

3. Development/Production

Recommendation #17:

That the Government of Alberta encourage the development of a courseware industry and that this encouragement be in the form of incentives, funding assistance, and shared research.

Comments:

We would like to see a strong and competitive courseware industry develop in Alberta. We feel that courseware can be produced most effectively and at a lower cost by private industry. Alberta Education should establish courseware specifications, which interested developers must meet if they wish to sell programs for use in Alberta's schools. 'Private industry' may include teachers, school jurisdictions, and agencies related to education, along with the businesses involved in courseware/software activities.

To assist in courseware development, Alberta Education should:

1. conduct detailed needs assessments by surveying teachers experienced in the use of computers in schools to determine what courseware is needed and to assign priorities to specific subject areas.
2. establish priorities and courseware standards for content, instructional format and technical design.
3. widely distribute these priority designations and standards.

4. provide support for the field testing, evaluation, and administration of Alberta produced courseware.

Those involved in courseware development who are interested in raising capital by equity participation might be advised to approach VenCap Equities Ltd., the newly established provincial venture capital company. As noted in the Throne Speech, this company has a particular interest in supporting high technology developments.'' Equity participation would favour companies with sound, long range prospects rather than those companies interested in financing short term projects.

Recommendation #18:

That the Alberta Government introduce tax incentives that will encourage private investment in the courseware/software industry; further, that the Alberta Government encourage the Federal Government to introduce similar tax incentives.

Comments:

Courseware development requires large front-end development costs. A tax credit to Alberta investors, of at least 20%, for the development of courseware/software in Alberta would likely generate the capital necessary to encourage private and corporate activity. In the recent Ontario Task Force

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''"In 1982, the Alberta Government established Vencap Equities Alberta Ltd. With $200 million from the Alberta Heritage Trust Fund, it will develop, diversify, expand and strengthen the industrial base of Alberta, putting particular emphasis on high technology". Quoted from the March, 1983, Speech from the Throne.

Report on Microelectronics, it was recommended that particular attention be given to "treating the design or programming of software as R and D and also treating the supply of software packages as a business eligible for exemption from provincial and federal sales tax, the same as in the hardware business"; and "... allowing manufacturing investment tax credits and accelerated depreciation allowances to be applied to the software and computer-service industries."[18] We agree with the Ontario conclusions that advocate the redefinition of R and D, for tax purposes, to include courseware/software design and programming.

Recommendation #19:

That the Government of Alberta encourage the Federal Government to address the issue of copyright of computer courseware/software.

Comments:

Copyright difficulties are a major obstacle to courseware development. In general, computer programs can be easily and quickly copied. Developers are spending a good deal of time and money in devising techniques to prevent courseware from being copied. There is a reluctance on the part of some software/courseware developers to enter the educational field until they are confident that their products, when marketed, will not be easily and illegally copied.

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[18] MICROELECTRONICS. Report of the Task Force to the Government of Ontario, Toronto, October, 1981. Excerpt of Recommendation #6, p. 8.

Recommendation #20:

That the Government of Alberta provide national and international marketing assistance to Alberta courseware developers who are attempting to market their products elsewhere.

Comments:

The provincial government, through the Department of Economic Development, can help Alberta's courseware developers - most of whom lack the resources to enter international markets. Obviously, some of the courseware produced that is consistent with the Alberta Program of Studies in mind will not be suitable for educators elsewhere. In the final analysis, courseware developers will make business decisions based on the expected market size and projected development costs.

Recommendation #21:

That the Government of Alberta support the development of courseware in areas of special need; in particular, for gifted and talented and handicapped students.

Comments:

There is a limited market for courseware which is specifically designed for developmentally handicapped students and for those who are gifted and talented. Specially designed courseware will be needed for these students. A designated fund could support the development of special courseware by providing developers with research funds, 'seed money', and consultative services. Before initiating any projects, a careful review of the existing courseware inventory should be conducted, as there are a number of programs available for a variety of special needs.

We expect that the Social Studies courseware may need support, as it is infused with information relevant primarily to Albertans.

Recommendation #22:

That quality courseware be sought to support the teaching of computer literacy; if not available, that it be immediately developed for use in Alberta.

Comments:

One of the methods of delivering computer literacy courses is through Computer Assisted Instruction programs. Suitable courseware, differentiated by grade level, should be a priority for acquisition in the short term.

Recommendation #23:

That Alberta Education utilize the services of ACCESS and other agencies, where possible, to co-acquire, reproduce, and distribute courseware/software.

Comments:

In a submission to the Task Force, ACCESS expressed particular interest in assisting Alberta Education in the acquisition, reproduction, and distribution of courseware. In the future, distribution of courseware may be done more effectively via broad-band telecommunications. Thus, it may be possible to distribute courseware through the facilities of ACCESS.

D. HARDWARE

Issue:

Hardware has been described by some commentators as the part of a computer system that can be touched. The equipment referred to as hardware includes a power source, storage devices, and circuits that transform, route and control the flow of information. A typical microcomputer learning station consists of a cathode-ray tube monitor, a Central Processing Unit (CPU) which stores and processes data and instructions, a keyboard and a disk or tape drive. Some computer systems use a wide variety of peripheral devices, such as printers and graphic tablets.

We expect that microcomputers will be the computers used most extensively in the schools of Alberta during the next five years. Microcomputers will become smaller, to the extent that they will fit more easily on students' desks, and will become relatively less expensive. Many students will have access to a computer at home.

Hardware issues should be examined immediately. While it is not necessary to make hasty purchase decisions, some hardware is required before other activities can begin. It is therefore essential to systematically acquire hardware for use at all levels of the school system. Decisions that are made must take into account the rapid rate at which developments are occurring, the fact that most product lines are not compatible, and the advisability of buying basic systems that can be further expanded. Of course, hardware capabilities set parameters for the development of courseware. This relates to the programming languages of different computers and features such as graphic capabilities. For example, some CAI courseware relies on high resolution graphics and colour, which certain microcomputers can not handle.

We have categorized the subsidiary issues of hardware as follows: evaluation and acquisition, distribution and placement; networks; and peripherals.

1. Evaluation and Acquisition

The hardware industry is evolving at a rapid pace. After reviewing the rate of developments of microcomputers over the past two years, and the wide variety of systems available, the Task Force reached two basic conclusions. The first is that no single brand is best for all applications. For example, a sophisticated computer might be ideal for word processing purposes and other high school business education applications, but it would be over-powered and costly for an elementary level computer literacy program. The second conclusion is that the primary criteria for the selection of a computer should be its suitability for the intended application. This takes precedence over other important considerations such as compatibility, and versatility. Of course, cost is an over-riding factor to be weighed against the relative merits of particular brands.

To systematically acquire hardware, it is necessary to first establish province-wide standards that relate to intended applications. Jurisdictions should be free to acquire any hardware they wish, but their investment decisions will be more sensible if they choose hardware that is compatible with provincial standards. Establishing hardware standards facilitates communication, the exchange of programs, and the development of appropriate courseware. Standardization, to the degree necessary, may sacrifice some of the attractiveness of individualization but is a sensible way to employ the available resources. It is for this reason that we advocate establishing several 'differentiated standards' which, subject to annual review, should receive provincial support.

Recommendation #24:

That Alberta Education develop and establish standards for the acquisition of computer hardware according to proposed application and that these standards be reviewed annually.

Comments:

To set standards for the acquisition of microcomputer hardware, it is first necessary to define standards that measure the suitability of features for the proposed application and which rate the technical design capacity, compatability, versatility, portability, reliability, durability and relevant ergonomic factors of the devices. Secondly, the availability of suitable software must be assessed.

We advise that hardware standards be established by Alberta Education, because such standards are an integral part of any provincial plan that might be developed. As well, this is a service Alberta Education should properly provide. As noted in Recommendation #40, an Advisory Committee should be set up to examine hardware issues and to offer guidance concerning appropriate standards to the responsible individuals within Alberta Education. Once the standards have been established, the various brands on the market must be evaluated. Computers that meet preliminary standards should be field-tested in the classrooms of cooperating teachers. The reports of these teachers would assist the Advisory Committee in recommending specific brands.

Recommendation #25:

That Alberta Education negotiate selected, provincial buy-agreements with computer manufacturers who meet the established hardware standards, and that these buy-agreements be re-evaluated as hardware standards are reviewed.

Comments:

Other jurisdictions, such as Minnesota, have had success in reducing the unit price of microcomputers bought in large volume by negotiating buy-agreements with computer manufacturers. We suggest that the Deputy Minister of Alberta Education designate an individual to negotiate buy-agreements on behalf of the province. These buy agreements would be for specified numbers of devices, perhaps group lots, at a fixed percentage discount from the retail prices for the recommended configurations, as reflected by the prices in the Alberta and Canadian market.

Recommendation #26:

That school jurisdictions purchase computer hardware, where possible, from local dealers who will be responsible for distribution and service.

Comments:

It is unnecessary for the province to distribute hardware from a central location if a dealer network already exists. Dealers are keenly interested in the educational market and should be encouraged to participate and gain expertise in educational computing. Local jurisdictions are free to purchase hardware from any dealer, but the negotiation of provincial buy-agreements should contemplate the distribution, servicing, and maintenance of hardware from local outlets.

2. Distribution and Placement

In planning the use of computers in schools, questions arise concerning the appropriate ratios of students to learning stations and where the devices should best be placed.

Ideally, each student should have his/her own computer learning station. Within the forseeable future, these computers may be small enough so that students may carry them home. In practice, the availability of resources dictates the number of computers that can be acquired - teachers will use the available hardware with as many students as time and appropriate courseware allow.

Schools vary widely in size, teachers have personal preferences about the placement of computers, and different applications require different ratios of students to computers. Consequently, we can offer only broad guidelines for appropriate use. Task Force members were reluctant to prescribe too narrowly an 'ideal' ratio or configuration, as we do not presume to know what is best in every instance.

Recommendation #27:

That there should be a minimum of one computer learning station for every eight students in a school.

Comments:

We have chosen a school with a minimum of 8 classrooms, with an average of 24 students per classroom as our primary unit of analysis. Without reference to applications, we advise, as a minimum, one computer learning station for every eight students should serve as a benchmark. If grouped into a laboratory, this ratio would yield 24 learning stations, or one per student in a class. Assuming an 8-period daily timetable, this would provide the student with computer access which is equivalent to one period per day; this is necessary for applications such as business education. This would also allow enough time for drill and practice CAI, which research suggests requires direct individual access of approximately 15 minutes per day. ''

For computer literacy programs, one computer station for every two students is adequate to introduce them to computing while providing sufficient opportunities for hands-on experience. The needs of computer literacy, particularly at elementary and early childhood levels can be met adequately by the low cost smaller microcomputers that are now available. In the near future, we expect the small computers to be as common as hand held calculators are today.

In cases where computer literacy is offered at junior high and senior high school levels, it can be done effectively if the computers are grouped in a lab format. We have seen computers in stationary and mobile groupings, in labs, in resource centres, in libraries, and in various classroom configurations, including clustered work stations, and are

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''Suppes, P. & Morningstar, M. Computer-Assisted Instruction at Stanford 1966-1968: Data, Models, and Evaluation of the Arithmetic Programs. New York: Academic Press, 1972, p.18.

not convinced that any one arrangement is best.

Recommendation #28 :

That for CAI and Business Education applications, one laboratory of computers for every 8 classrooms be established at the junior and senior high levels.

Comments:

As discussed above, the laboratory format, with one student per computer and proper scheduling, allows for direct, regular access and full use of the learning stations throughout the school day.

3. Networks

'Networks' is a term used to describe an interconnected system of computers and/or terminals that share access to a common data base.

Recommendation #29 :

That Alberta Education encourage the establishment of computer network systems and establish a central data bank to support these networks.

Comments:

By linking together the classrooms of a school, the schools within a school jurisdiction, and the school jurisdictions of the province, a networking system can significantly support the delivery of education in the province.

Local Area Networks (LAN) are becoming practical and can be set up at a reasonable cost. Within a school or if extended to other schools, such systems can permit the exchange of memoranda, act as an electronic bulletin board or electronic mail system, process work orders and purchase orders, maintain accounting records, store and retrieve student data, store and retrieve employee data and provide teacher access to a central test-item bank. Each of these applications, if supported by an adequate data base and sufficient hardware, can help teachers reduce the amount of time they spend on administrative matters. Already, in a number of schools, microcomputers are used to record and produce student attendance records and report cards.

A province wide test-item bank is a good example of the service computers can provide. If a central bank of properly validated, filed and categorized test items is established, teachers will be able to generate specific exams by submitting a request via a network link to a host computer. Tests produced in this manner can be identical or comprised of questions of equal difficulty to yield equivalent tests. The security of student evaluation becomes less troublesome when teachers can easily administer equivalent exams. The test could be delivered to the teachers via a digital or telephone network, and the teachers could then run it off on a printer located in their school or classroom. A computerized test development system, could serve teachers when they choose to use it, and would not prevent anyone from using other means.

Recommendation #30:

That Alberta Education set network standards to enable school jurisdictions in the province to electronically communicate with each other and with centralized data bases.

Comments:

To encourage the establishment of network systems, Alberta Education will have to develop network standards to ensure compatibility of hardware. This does not have to be formalized immediately, but preliminary discussions between Alberta Education and school jurisdictions, as well as experimental work should commence as soon as possible.

4. Peripherals

Significant advances have been made in the development of mass storage devices and computer peripherals. The price and quality of terminals are improving constantly. Better speech synthesizers are being devised and the price of optical card readers is dropping. Modems are being improved - the price of reasonably efficient modems is now within the reach of many people, allowing them to transmit data more rapidly and at a lower cost.

Peripherals enhance the versatility of computer systems. Music synthesizers, graphic input devices, mice (moveable ball-tracking devices) and low cost printers are components of computer systems that allow students to develop their creative abilities. Specially designed peripherals are required by some physically handicapped students to enable them to communicate with computers.

Recommendation #31:

That Alberta Education encourage the development and introduction of computer peripherals that will enable all handicapped students, including physically handicapped, learning disabled, and developmentally delayed students to communicate with and use computers.

Comments:

Further work needs to be done to enable physically and mentally handicapped students in the province to use computers. This will require some research and review of the efforts of others. We hope that groups interested in special education would consider cooperating to investigate the ways in which computers can be used by these students .

E. PLANNING

Issue:

We are entering a new field of endeavour in education.

There are few proven models to follow. In addition, few people have experience in initiating comprehensive educational computing programs. Many activities have been conducted on an experimental basis, to test the effectiveness of courseware, instructional strategies, and hardware capabilities.

Plans should define what is to be accomplished, and thereby improve the use of resources. Further, plans should provide a structure and define the purpose of proposed activities. Ideally, this involves coordination of effort and constructive use of resources. A decision-making mechanism should be created, and the locus of responsibility should be defined. The plans that are formed should be designed to be integrated with a process of two-way communication and a regular monitoring of progress.

Leaders, emerging at all levels, will convert the plans into action. We recognize and commend the initiative of the Minister of Education and officials of Alberta Education, and the efforts that teachers have made regarding educational computing.

Recommendation #32:

That Alberta Education provide bold and decisive leadership in educational computing.

Comments:

Judging from our experiences and the experience of others, leadership is one of the fundamental pre-conditions to the successful implementation of educational computing. Leadership does not, in and of itself, make things happen. However, leadership does provide the vital force that can make things happen. Leaders must be supported by resources, be adaptable, and have the capacity to reliably deliver services.

The challenge for Alberta Education and the provincial government is to provide leadership that is not formalized, institutionalized, and centralized. Rather, leaders must recognize the potential of educational computing, anticipate change, and be able to respond to change. A strategic planning capability within Alberta Education would help provide the leadership that the province needs.

Recommendation #33:

That Alberta Education develop a comprehensive, strategic provincial plan for educational computing, which shall be reviewed at least once per year.

Comments:

This plan should be based on an evaluation of the success of provincial programs and the adequacy of services provided. It should review the direction in which the province is moving and assess existing programs and activities according to defined priorities. It should detail new programs and their goals. This plan needs to be more than a list of activities - it should clarify the objectives of educational computing and review projects and programs within that context.

This plan should be made available to the public.

Recommendation #34:

That Alberta Advanced Education, in conjunction with Alberta's universities and Faculties of Education, develop a plan to implement these recommendations that have implications for teacher training, and that this planning be initiated as soon as possible.

Comments:

As the three Faculties of Education in the province prepare teachers who face similar challenges, we consider it advisable that they coordinate their efforts in articulating a basic course for the training of teachers. It would be advantageous if the universities in cooperation with Alberta Advanced Education would try to ensure some degree of similarity in their course offerings.

Recommendation #35:

That each school jurisdiction in Alberta develop a multi-year plan for educational computing, to be reviewed and updated at least once per year.

Comments:

This plan would deal with the issues of educational computing that are relevant to the school jurisdictions and define educational objectives, resource and equipment requirements, and inservice plans. It might include certain common features to assist in the sharing of information with others in the province.

Recommendation #36:

That each school jurisdiction appoint an individual to coordinate the development and implementation of its educational computing plan.

Comments:

The person delegated the task of producing an educational computing plan might in fact be designated as the educational computing coordinator for the school jurisdiction. This individual should have specialized training in educational computing.

F. ORGANIZATION

Issue:

The major issues of educational computing will endure, although they are evolving and their emphasis may change. An organization that is durable enough to be stable and reliable, yet flexible enough to adapt to change, must be structured to support the delivery of the required services. It must be permanent enough to provide continuity and coherence to the programs that have been initiated.

The staff members of this organization should be technically knowledgeable and be aware of the needs of educators and students. In addition, they must be skilled planners and able communicators.

Recommendation #37:

That Alberta Education establish an Educational Computing Branch within the Program Development Division of the Department.

Comments:

This Branch should be a distinct part of the department. It should be headed by a Director whose responsibilites should include: development of a provincial plan for educational computing, support of inservice programs, development of courseware standards, distribution of courseware evaluation results, coordination of on-going research, and representation of Alberta Education at appropriate conferences and committees. Those within this branch must be able to provide considerable consultative support when needed. The present Computer Technology Project should be integrated into this branch.

Recommendation #38:

That Alberta Education create the position of Computer Consultant and assign at least one Computer Consultant to each of the Regional Offices of Alberta Education.

Comments:

Among general responsibilities, this consultant would:

- provide general consulting services
- assist in drafting educational computing plans for local jurisdictions
- advise school jurisdictions on the structure and delivery of inservice programs
- offer advice on the placement, selection, and use of various types of hardware
- disseminate information, particularly information related to courseware.

At the outset, consulting services will likely be provided to those school jurisdictions that are active in this area and who have requested assistance. However, this consultant should try to ensure that resources are distributed as equitably as possible within the province.

Recommendation #39:

That the Minister of Education consider establishing a Minister's Advisory Committee that would review directions, policies, programs, services, and other matters relating to educational computing.

Comments:

This Advisory Committee would have no more than 12 members and would be chosen from reference groups in education and the informed public at large.

This committee would not have representation from Alberta Education, but would be empowered to seek assistance and advice from staff of the Department. The role of this committee would be to provide the Minister with an objective assessment of the directions and progress being made in educational computing in Alberta. An annual report should be made to the Minister.

Recommendation #40:

That advisory committees, reporting to the Director of Educational Computing, be established to provide advice on specific issues in educational computing and to keep the Director informed about developments within the province.

Comments:
These advisory committees would assist the Director in making decisions by obtaining advice and input from those in schools and by communicating this information back to those in the schools.

Committees are needed for hardware, courseware, and teacher inservice. All regions of the province should be represented by the committee members. These committees should be composed of fewer than eight members and should be chaired by the official from Alberta Education responsible for the program area. The committee members should be computer coodinators of school jurisdictions. These advisory committees are intended to offer specialized advice and are not intended to form policy. Consequently, representation from reference groups should not be required.

The chairman should select committee members following nomination of individuals from school jurisdictions in the province.

Recommendation #41:

That the Minister of Education encourage the establishment of a Committee consisting of senior representatives of government departments to assess the implications of high technology for the educational system, and for business and industry in the province.

Comments:

This committee would ensure that government officials are fully aware of the plans and programs of other departments when drafting proposals related to high technology. This committee should seek to coordinate initiatives to avoid duplication of effort.

Recommendation #42:

That the Minister periodically convene a public seminar to examine the social significance of technology and its implications to education.

Comments:

This seminar should be organized to bring Albertans of diverse backgrounds together with national and international authorities. Their discussions could be broadcast province-wide with the assistance of ACCESS. We feel that the participation of parents and representatives of the business community is of particular importance to such a seminar.

G. FUNDING

Issue:

Educational computing requires a significant financial investment. We urge the provincial government to provide the strong financial support needed. School jurisdictions do not have sufficient resources to fund the initial costs of educational computing, particularly during this period of financial restraint. If the provincial government, through Alberta Education, agrees with our conclusion that the objectives cited in this report are of a high priority to the province, and is able to provide reasonable financial support, these goals can be reached.

We believe that the arguments in favour of introducing computers into our schools are profound and compelling. This conclusion is reinforced by the decisions other provinces have made.

As discussed earlier, Quebec recently announced plans to invest $150 million in the school use of computers over the next five years. Ontario plans to invest $10 million in hardware acquisition and $6.96 million in software development alone in the 1983 and 1984 fiscal years.

The components of the educational computing endeavour are interdependent. In a comprehensive program, the areas of teacher training, hardware acquisition, courseware acquisition and development, and research need to progress simultaneously. This will occur only with balanced funding that allows resources to be distributed proportionately, when and where required.

To ensure support for the enterprise, we advocate going beyond the conventional means of government funding.

Recommendation #43:

That the Government of Alberta establish an Alberta Heritage Foundation for Educational Computing to provide funding support for the recommendations of this report.

Comments:

We consider it advisable that the Provincial Government arrange the transfer of funds, in the order of $100 million, to a foundation created to support educational computing in Alberta. The interest earned by this fund would be distributed by the foundation. The fund would be used to finance a proportion of the costs faced by school jurisdictions to acquire computer hardware, to support courseware development (in particular for students with special needs), to support teacher training, and to fund research projects. The objective is to provide funding when needed and where needed so that initiatives receive balanced support.

Task Force members recognized that it was beyond our mandate to calculate the costs of various programs. However, we feel a fund in the order of $100 million would generate enough revenue to proceed with the programs we have highlighted. To illustrate the magnitude of the funds required, it is helpful to refer to recent activities.

The Social Studies curriculum inservice program introduced approximately 7,000 Alberta teachers to the new Social Studies curriculum in 1981-1982, at a cost of $2.6 million. As noted in Section III, Part B, educational computing requires a more extensive inservice program to provide ongoing inservice courses for all teachers. Inservice is, of course, only one part of teacher training.

If the fund earns $8 million to $10 million per year for the next five years, that will result in a return of $40 million to $50 million. This compares favorably to Quebec's plan to invest $150 million over the next five years, for about three times the number of students.

In the recommendations that follow, specific projects are referred to which could be funded through the Foundation, or through other means.

Recommendation #44:

That the Government of Alberta, through Alberta Education, provide the major portion of the funding and incentives to carry out the recommendations contained in this report.

Comments:

As noted, significant funds are required to acquire hardware, train teachers, purchase and develop quality courseware and establish networks.

Recommendation #45:

That the funding be provided in various forms, including ear-marked grants, matching grants, and various incentives.

Comments:

Ear-marked grants are an effective means of funding specific activities, and are particularly appropriate for hardware acquisition, and inservice programs. For example, inservice might best be funded on a per teacher basis that allows teachers the latitude to take the courses they wish. We suggest that the funds of ear-marked grants for hardware acquisition not be advanced to a school jurisdiction until it has an acceptable educational computing plan in place.

Recommendation #46:

That programs such as the Building Quality Restoration Program (BQRP) and the Educational Opportunities Fund (EOF) be continued, to provide financial assistance for hardware acquisition and educational computing projects.

Comments:

These programs have funded a number of efforts that have been well received. The capital costs of furniture and facilities can be addressed through the BQRP.

Recommendation #47:

That model, 'high-tech' schools be established and jointly funded by Alberta Education and cooperating school jurisdictions.

Comments:

These schools should be designed as prototypes, to test the instructional and administrative strategies of educational computing. A model school should be located near each of the universities to allow for close liaison and cooperation between the local Faculty of Education and the school. The focus of activities would be on curriculum design, instructional strategies, equipment configurations, demonstration projects, innovation, research, and administrative use of computers. Teachers at these schools would have individual computer stations to aid in record keeping, tracking student progress, accessing test item banks, and communicating with other teachers through a school-wide communications network. Attention should be devoted to establishing curricula for emerging high-tech related academic and vocational programs, and to the testing of new hardware and its appropriate configurations. Also, courseware, graphic requirements, and innovative approaches to instruction could be tested. Particular attention could be devoted to students in special classes.

These schools would benefit from the participation of the private sector. As noted in a recent article in Business Week[28] a number of companies in the United States have 'adopted' local schools. Their staff work with students in programs designed to offer insights into a wide variety of issues. We believe there are a number of highly skilled and able individuals in Alberta who would participate in such programs.

Recommendation #48:

That Alberta Education establish a designated fund for the support of courseware development for students with special needs.

Comments:

This need for the fund was highlighted in Recommendation #21, and is reiterated here because it requires a distinct funding mechanism. The amount of money required can be determined only by first carefully reviewing the courseware currently available for students with special needs.

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[28] Low-Tech Education Threatens the High-Tech Future, Business Week, March 28, 1983, p. 96.

V. RESEARCH AND IMPLICATIONS

A. Research

In the course of our discussions, we identified a number of issues that require further examination. Some fundamental questions arose which we could not answer; nor could others, as we deduced from a review of the published literature.

The issues we have identified need to be researched in a controlled, verifiable, and systematic manner. For certain purposes, the best means of investigation and assessment may be by demonstration and experimental projects, conducted perhaps in the 'model schools'. Careful efforts must be made to monitor these projects and evaluate the results of other educational computing activities. With the assistance of sound research, we can refine our approaches and enhance the benefits attained.

The issues we have identified include the following: the effects of computing on the learning process, the role of teachers, and the organizational structure of schools, the mental and physical effects of computer use on students, and the implications of computers to social attitudes and relationships. The object of the research is to refine our understanding of specific matters so that we can make computers serve us better.

In due course, these questions must be addressed. The Director of Educational Computing, assisted by appropriate Advisory Committees, should decide research priorities and establish a long range research plan. Research studies should be tendered, according to practice, to interested individuals, school jurisdictions, universities, and consultants.

Research will require provincial government support. Recognizing the need for reliable research, we advise that this support be set at $1.5 million per year, on average, for each of the next five years; approximately 50% of this amount could be used to support the model schools described above.

The following issues require further research:

1. In Computer Assisted Instruction, how much time at a computer learning station is desirable for each student? What guidelines are advisable to assist teachers in designing instructional strategies that incorporate CAI? At specified achievement levels, in particular subjects of study, what is the ideal? Are there useful measures of optimal times at a computer learning station, and

appropriate sequencing and presentation of instructional material (e.g., tutorial, drill and practice, simulation, etc.)?

2. Are any of the conventional computer programming languages more or less suitable than others for the instruction of programming? For example, the Alberta Education Computer Literacy Pilot Project is finding that many children in Grade Four have difficulty in learning BASIC because of a conceptual problems with the notion of variables. Are there inherent differences between computer languages, relative to their structure and other variables, that impinge on their ease of learning, adaptability, and utility? How does this affect decisions regarding the selection and purchase of hardware?

3. Is the cognitive development of children affected by learning how to program and use computers? Can the effects, if any, be measured in a meaningful way? Does the learning of algorithmic and heuristic processes enhance creativity and problem solving? At what ages, and to what degree can average school children benefit from learning computer programming?

4. How can we implement alternative approaches to develop skills by using computer technology? Can the departmentalization of subjects be reduced by alternate, intergrated approaches of delivering instruction?

   Which courseware designs are most effective in delivering instruction - specifically with reference to subject and achievement level? How can courseware be best designed to accommodate continuous student progress and effectively monitor individualized instruction?

5. What are the relevant ergonomic factors and what are the effects upon learning and the mental and physical wellbeing of the students and teachers? What practical measures can be taken to enable people to use equipment without discomfort or endangering their physical and mental health? What are the implications of prolonged exposure to video display terminals? In what way do ergonomic factors effect concentration, attention, and stress level of individuals?[31]

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[31] A monograph called Computers 5, distributed by Alberta Education in January of 1983, reviews the use of video display terminals and the effects upon the work environment and the stress of workers. It includes the observation that VDT use may contribute to eyestrain. It notes that video display terminals do not pose a radiation health hazard, but that the organizational structures of offices and attitiudes of people often do not adapt to the capabilities of new

6. Is there any relationship between age, gender, and computer use? What is the explanation for the reduction in interest in computing by girls as they advance to higher grades? Woud equal use of computers affect the development of scientific and mathematic performance of girls as opposed to boys?[22]

7. What are the most practical designs for the implementation of an interactive computer network? How can classrooms, schools, and administrative offices be effectively linked? What administrative functions can be best supported, in the short-term, by an interactive network? In its submission to the Task Force, the Edmonton Public School Board expressed strong interest in the potential of computer networks for administrative purposes.

8. What are the hardware requirements for classrooms, laboratories, and libraries? Given specific courses and student achievement levels, what are

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[21](cont'd)machines - this results in stress.

[22] In Alberta schools during 1980-81, the enrollment in Physics 30 consisted of 26% females and 74% males; in Computing Science 30 the enrollment consisted of 35% females and 65% males.

the ideal configurations, and ratios of students to computer learning stations, How can various types of hardware be effectively integrated into the learning process?

B. Implications

We draw a distinction between specific issues which require research and the broader implications of the widespread use of computers in schools. The implications are the social and structural consequences use of computers in schools. The following questions call for indepth assessment:

1. How will educational computing affect the role of teachers? Will the use of computers require teachers to modify the preparation and conduct of their instructional activities? Will the use of computers permit a significant increase in the amount of time available for individualization of instruction? Can use of computers alleviate some of the tension and stress that teachers experience? How will computers affect the attitudes of teachers?

2. What will be the impact of educational computing on the organization of classrooms and schools?

3. How will the use of computers affect the relationship between the home and the school? Will the locus of control of education shift dramatically to parents as more computers are acquired for home and personal use and quality courseware becomes available to the public? What are the implications of distance education? Will changes to the statutory provisions that relate to compulsory school attendance and home schooling be required to accommodate the delivery of education over a distance?

VI. SUMMARY AND CONCLUSIONS

We have a reasonably clear vision of the future that we foresee for educational computing in Alberta. We wish to have our children graduate from school prepared to function and contribute to their community. We want the province to be prosperous enough to offer meaningful career opportunities to our school graduates so that they need not move away in search of challenge and reward.

Our recommendations direct the province toward that future. Let us summarize them to clarify 'where we think the province should be' in five years time.

Within the next 5 years, we forsee the following:

1. all students graduating from Alberta schools will be computer literate
2. all teachers graduating from Faculties of Education of Alberta universities will be computer literate. All those interested in computing will have an opportunity to study the instructional use of computers, in depth, as a specialty at both the undergraduate and graduate levels.
3. each school district in Alberta will have a minimum of one trained teacher on staff as a computer specialist to provide guidance, technical

assistance, and support in instructional computing. In larger jurisdictions, other positions will be in place in administration and planning.

4. teachers who wish to, will have access to a computer for administrative purposes.
5. all schools in the province will have some computer hardware, in most cases microcomputers. They will cost much less in comparison with today's prices. In general, we forsee a minimum of one computer station for every eight students.
6. quality courseware will be more readily available and a courseware distribution network will be in place.
7. Alberta will have a viable courseware/software industry producing material for use in the province and elsewhere.
8. a structure will be in place within Alberta Education to provide technical and advisory support to Alberta school jurisdictions. Working closely with teachers, administrators, and trustees, officials from Alberta Education will establish hardware standards, negotiate buy-agreements with manufacturers, evaluate courseware, assist in courseware development and provide leadership in planning for uses of computers in Alberta schools.

9. instructional, informational and administrative computer networks will proliferate, linking together teachers, classrooms, schools, school jurisdictions, regions, and provinces. Networks will enable educators to share information resources (e.g., such as test item banks).
10. computers will virtually replace standard typewriters in the classrooms and offices of the province. In response to employer requirements, business education classes will continue to move towards microcomputers and a mastery of word-processing skills.
11. there will be legislation in place protecting the confidentiality of individual student data stored on computer information/data bases.

CONCLUSIONS

In this report, reference has been made to the astonishing rate of technological development that appears destined to continue without hesitation. These developments are agents of change that confront all of us - our lives and the means by which we acquire a livelihood are being strongly transformed.

We, the members of the Task Force, have put forward the view in this report that the students in the province's schools, indeed that students everywhere, must have an opportunity to learn about high technology and, particularly, computers. This is hardly a revolutionary notion. The independent initiatives of teachers, strong support of parents (some of whom have purchased computers for home use), and decisions made in other provinces and countries support this view.

Students will need computer knowledge and skills to understand and manage the changes they will face. School graduates must be prepared to participate in a competitive work world pervaded by computers.

Prevailing trends indicate that a technological capacity is fundamental to the long term prospects of an economically diversified province. Future job opportunities and career challenges depend upon the acquisition of this capacity. Of course, this holds true for the country as a whole. A recent Science Council of Canada study [23] stated: "In the quest for survival that is sweeping a very competitive world, economic policy has now become technology policy. Can Canada compete?" The Task Force suggests we must try to do so.

This discussion of educational computing has been guided by an abiding concern for the children of Alberta and their future. We have identified a pressing and urgent need to introduce computers into Alberta's schools. The recommendations contained in this report, if followed, will encourage and support this enterprise. We hope that these recommendations will form the basis of decisive action and urge that they be given serious consideration.

We hope that our efforts have been of assistance to the Minister of Education and to all Albertans.

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GLOSSARY OF MICROCOMPUTER TERMS

Acoustic Coupler: A form of modem which permits attachment of an ordinary telephone handset so that a computer can communicate to another computer by using any telephone. (See MODEM.)

Algorithm: A series of instructions or procedural steps for the solution of a specific program.

Alphanumeric: A character which is a letter or a numeral.

Analog: The representation of numerical quantities by means of physical variables such as voltage, current or resistance.

ASCII: Acronym for American Standard Code for Information Interchange. Computers use a numerical representation for letters, numerals, and special characters. This standard specifies which number will stand for each character. All personal computers use this standard.

Assembler: A program that translates assembly language into the computer's native language.

Authoring language: A collection of programs which enable the course author to use English language instructions instead of a programming language to communicate with the computer.

BASIC: Beginners Allpurpose Symbolic Instruction Code - A popular programming language which is a standard feature on almost all microcomputers.

Baud: A measurement of communications speed between devices.

A baud usually - but not always - refers to bits transmitted per second. When divided by 10, a baud usually represents the number of characters transmitted per second.

Benchmark: A standard or point of reference used to compare the capabilities of different computer systems.

Binary: A base-two number system (as opposed to decimal which is base ten) where all digits are either 0 or 1. Binary is the system used internally by computers.

Bit: The smallest unit of information storage. A single bit can specify either of two alternatives. Derived from "BInary digiT", meaning either a one or a zero, a simple yes/no choice.

Bug: An error. A hardware bug is a malfunction or design error in the computer or its peripherals. A software bug is a programming error.

Byte: A series of bits (eight in most microcomputers) which together represent a single letter, number, or special character. Usually a byte is equivalent to one keystroke on a typewriter. Microcomputer memory size is often measured in bytes.

Chip: A piece of silicon the size of a fingernail, upon which an integrated circuit is etched. The circuit contains logical patterns of computer processing. A number of chips are cut out of a larger wafer.

Command: A request to the computer that is executed as soon as it has been received. Sometimes this word is used interchangeably with the terms "instruction" and "statement". Those terms properly refer to portions of programs and not to commands which are carried out immediately.

Compiler: A program that converts English-like commands into instructions that can be executed by a computer.

Computer: Any device that can receive and then follow instructions to manipulate information. In any computer, both the set of instructions and the information on which the instructions operate may be varied from one moment to another. A device whose instructions may not be changed is not a computer. The distinction between a programmable calculator and a computer is that the computer can manipulate text as well as numbers, whereas the calculator can only handle numbers.

CPU: The abbreviation of "Central Processing Unit," an obsolescent term for that portion of the computer which controls peripherals and memory. The CPU was once a separate part of a computer but the term has lost its usefulness in personal computers where it refers to a tiny portion of one of the chips in the machine.

CRT: Cathode Ray Tube - A television-like screen used for display of computer input and output.

Data: Information of any kind. Often the idea of numerical information is implied.

Data Base Management: A program or collection of programs designed to structure information to facilitate storage and retrieval.

Digital: Used to describe information that can be represented by a collection of bits. Most modern computers store information in digital form.

Disk Drive: A peripheral which can store information on and retrieve information from a disk. A floppy disk drive can store information on a floppy disk, and can retrieve that information.

Documentation: Written descriptions of software, courseware, and hardware.

DOS: Disk Operating System - A collection of programs which enable the disk drive to operate effectively.

Dot matrix printer: An inexpensive printer that creates characters by using a series of wires that produce dots, generally five dots wide by seven high. These are more suitable for home use than for business correspondence.

Editing: Making corrections or changes in a program or data.

Editor: A program which facilitates modifications or changes in programming statements or text.

Execute: To do what a command or program specifies. To run a program or portion of a program.

File: A collection of similar data, or a group of related records, treated as a unit.

Firmware: A computer program permanently fixed inside a chip, which remains intact even if power is lost. Many routine operations are encoded into the machine to improve efficiency and relieve programmers of repetitive tasks. One example of firmware is ROM (Read-Only-Memory).

Hard Copy: Information printed on paper or other durable surface. This term is used to distinguish printed information from the temporary image presented on the computer's CRT screen.

Hard Disc: A disc made of rigid ceramic-like material with a magnetic coating. It is kept in sheltered environment to prevent damage from dust, smoke and other pollutants.

Initialize: To prepare a disk for storing information.

Input: Information fed into a computer. Usually input is used together with output.

I/O: Input/Output - Usually used as an adjective describing a device which is used for entering and/or displaying information. Printers, keyboards, disk drives and CRT's are all I/O devices.

Interface: The connection between two devices, such as the computer and the keyboard, or the conventions for passing control and data between two programs.

Instruction: The smallest portion of a program that a computer can execute. The term is used with a number of other less clearly defined meanings. Its meaning in such cases parallels its usual meaning in English: a statement directing something to perform an action. See PROGRAM.

Interpreter: A program that allows a computer to directly execute instructions and commands in a computer language which is different from the computer's native language.

K: Kilo - One thousand and twenty-four. Memory size is usually measured in K's of bytes (for this application, K is actually 2^{10}, 1024, often rounded-off to 1000).

Keyboard: A typewriter-like arrangement of keys used to enter letters, numbers, and special character into a computer.

Language: A standardized set of instructions which allow a user to create programs to direct the operations of a computer.

LOGO: A computer language developed at Massachussets Institute of Technology specifically for use with children.

Memory: The circuits in a computer used to store information.

Menu: A list of options within a program which allows the user to make selections. Menu driven software can be more flexible and still be well-suited for a user's specific application.

Microprocessor: An integrated circuit that performs the task of executing instructions. The presence of a microprocessor in a product does not make it into a computer.

Modem: An abbreviation of the words "MOdulator/ DEModulator." It is a device that allows a computer to communicate over the telephone lines (and other communication media). It does this by changing the digital information into musical tones (modulating) and from musical tones to digital information (demodulating).

Monitor: Either a television set - often one that is specially manufactured to be connected to a computer; or a program supplied by the manufacturer that allows the user to control the operation of a computer. With computers that operate directly in a higher level language, such as BASIC, the monitor is often built into the language.

Multi-tasking: The ability of the computer to do more than one job or program at the same time.

Native Language: The language that a computer was built to understand. This language is usually rather inconvenient to use. Thus, most computers are provided with other languages as well.

NETWORKS

Operating system: The set of programs that make it easier to operate the computer. It does tasks such as accepting and interpreting information entered through the keyboard.

Operator: A symbol that represents a mathematical operation, such as addition, division, comparison or exponentiation, to name a few.

Output: Information leaving from a device or process. For example, the output from a computer can be displayed by a printer or CRT.

PASCAL: A programming language developed for computer scientists which is often available on microcomputers. It is more structured than BASIC.

Peripheral: A device that can send information to and/or receive information from a computer. Some typical peripherals are: floppy disk drives, printers, modems, and television sets.

Personal Computer: A general purpose microcomputer that is inexpensive enough to be owned by an individual with a moderate income.

Pilot: An authoring language designed for educational applications which is available on many microcomputers.

PLATO: A computer-based instructional system developed at the University of Illinois and distributed commercially by the Control Data Corporation. The University of Alberta operates a PLATO system.

Port: The place where connectors for peripherals are plugged into a computer.

Prescribed Learning Resources: Those learning resources approved by the Alberta Minister of Education as being most appropriate for meeting the majority of goals and objectives for courses or for substantial components of courses outlined in provincial Programs of Study.

Printer: A peripheral that makes a hard copy of letters and numerals. A line printer prints a whole line of text at a time. A serial printer prints one character at a time.

Program: A sequence of instructions that describe a process.

A program must be in a language that a computer can understand.

Programmer: Usually a person who writes and documents programs

RAM: An acronym for Random Access Memory. RAM is also known as main or internal memory. Memory can be altered by writing over previous contents. Generally RAM is volatile and the contents are destroyed if electrical power is lost. A more appropriate term would be Read/Write Memory.

ROM: Acronym for "Read-Only Memory". This is a kind of memory in which the information is stored once, usually by the manufacturer, and cannot be changed. Programs such as a BASIC interpreter, that are used by nearly all owners of a computer, are often stored in ROM.

Recommended Learning Resources: Those learning resources approved by Alberta Education because they complement Prescribed Learning Resources by making an important contribution to the attainment of one or more of the major goals of courses outlined in the provincial

Save: To store a program for later use. Since RAM is volatile, saving is usually accomplished by recording the program on a disk or cassette.

Scroll: To move text and graphics displayed on a CRT to make room for more text and graphics. Scrolling usually refers to up-and-down movement, but can be used to describe side-to-side movement as well.

Software: A program or collection of programs which cause the computer to carry out specific functions.

Stand-alone: A device that is self-contained, not dependent on another unit for memory or processing.

Statement: An instruction.

Supplementary Learning Resources: Those additional learning resources identified by teachers, school boards, or Alberta Education to support courses outlined in the provincial Programs of Study by reinforcing or enriching the learning experience.

Terminal: A peripheral which allows a user to type in information on a keyboard and display it on a CRT or a printer.

Text: Information which consists of words rather than numbers.

Time sharing: An arrangement in which more than one user can interact with a computer at any given time.

User-friendly: A machine that is simple to operate and easily understood by the average user.

Variable: A name for a quantity. A variable in a computer language can be thought of as a storage location into which a value may be stored. Such values are, typically, numbers and strings. More sophisticated systems may allow the value of a variable to be a picture, an array or some other structure

Vendor: A company which sells computer hardware, software, courseware and/or related services.

Word Processing: A program or collection of programs which permit the storage and editing of text.

COMPUTERS IN SCHOOLS

The Report of the Minister's Task Force on Computers in Schools

Executive Summary

June 1983

Alberta
EDUCATION

SO 014 196

COMPUTERS IN SCHOOLS

REPORT of the
MINISTER'S TASK FORCE on
COMPUTERS in SCHOOLS

EXECUTIVE SUMMARY

JUNE, 1983

Alberta Education

PREFACE

On October 23, 1981, the Honourable David King, Minister of Education, announced his intention to establish a Task Force to study the use of computers in Alberta schools. In a speech delivered to the Annual Conference of the Alberta Society for Computers in Education, Mr. King stated, "I propose that the Task Force have 12 members, to reflect the broad base of interests in the project. It will be responsible for making recommendations regarding pertinent issues. These include the organizational and instructional implications of the use of computers, and the feasibility of establishing an educational courseware development and marketing capability in Alberta. The mandate would include proposing suggestions for long range planning, and for the instructional and administrative uses of computers in Alberta schools".

The Task Force on Computers in Schools was established by Ministerial Order on November 16, 1981. It was organized during the spring of 1982, was convened July 17, 1982, and concluded its deliberations April 18, 1983. With the addition of one more representative, the Task Force was constituted with thirteen members, drawn from the public-at-large and all major reference groups in education in Alberta.

Copies of the full report may be obtained from the Communications Branch of Alberta Education.

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I. TERMS OF REFERENCE

The Task Force was directed to review educational computing issues and make recommendations to assist the Minister of Education in forming policies and programs for the province. Specifically the terms of reference stated that:

> . . . the Task Force shall have responsibility for reviewing problems and challenges, and for making recommendations to the Minister related to the following:
>
> 1. instructional implications of the use of computers in the province and in Alberta schools;
> 2. organizational implications of the use of computers in the province and in Alberta schools;
> 3. research studies that should be conducted relative to (1) and (2) above;
> 4. advisability and feasibility of establishing an educational courseware development capability within Alberta, including the best method(s) of setting up such a capability; costs associated with each method; courseware standards that should be established; and legal ramifications related to courseware development (e.g., copyright);
> 5. policies and practices re: introduction of computer hardware;
> 6. where Alberta schools should "be" in 3 to 5 years with respect to computers; and
> 7. such other matters as the Minister may refer to it from time to time.

II. INTRODUCTION

This report is concerned with the children of Alberta and the responsibility that we all share in helping them to prepare for rewarding and productive lives.

The members of this Task Force believe that the students in Alberta's schools must have opportunities to learn about computers and how to use them. Everyone will need this knowledge and these skills in the future, in their work and in their personal lives. Furthermore, the understanding of and the ability to use technology is a prerequisite to long-term economic prosperity for Alberta.

This Task Force was asked to review the use of computers in Alberta's schools over the next three to five years. With this in mind, a series of recommendations were produced which chart a direction we suggest should be followed. We feel that these recommendations will help educators maintain and improve the quality of education, while adapting to changing economic and social conditions.

This Task Force wants computers put to work in Alberta's schools, as aids to learning, instruction, and administration. We are excited by the potential of educational computing. Computers can be used to support and stimulate student learning, and can be used by teachers to improve the quality of education.

To be successful, the educational computing enterprise needs leadership at all levels, carefully developed plans, and sizeable amounts of money. Judging from the number and extent of local activities, there is obvious leadership potential that can be developed with appropriate support. With further experience and advanced training, planning capabilities can be strengthened and extended. However, progress depends upon funding support. We feel that investment in educational computing will yield direct benefits to the children of Alberta, to the province and to the country. It is an investment in people and in the future. Investing in human resources is of fundamental importance for humans alone are dynamic and have the capacity to create.

We feel that this endeavour deserves the attention of all Albertans, and would benefit from their support. Across the province, many people are enthusiastic and keenly interested in this subject. We want our education system to do more than keep in step with this interest - we expect educators to be leaders in adopting and adapting innovations of computers to the learning needs of students.

Our discussion of educational computing has been guided by an abiding concern for our children and their future. Every recommendation that we have made recognizes our shared responsibility to prepare the children of Alberta for a future which will be significantly different from the present. Much of the well-being of future generations and prosperity of our province depends upon this preparation.

We are on the verge of technical, economic, and educational change of an order not seen before. The question is not whether we can afford the effort and cost required to introduce computers into our schools. Rather, the question is whether we can afford NOT to do so.

III. RECOMMENDATIONS

A. STUDENTS AND CURRICULUM

Recommendation #1:

That by 1985 all students in Alberta schools shall have regular access to a computer learning station.

Recommendation #2:

That the Minister of Education initiate a review of the Program Studies to:

- introduce components related to technology and its current and future impact on society.
- adapt the sequence, structure, and design of the Program of Studies to accommodate continuous student progress and to encourage a personalized, self-directed learning approach.
- modify the content of appropriate courses to allow for the use of computers in ways that will stimulate the problem solving and creative abilities of students.

B. TEACHER TRAINING

1. Preservice

Recommendation #3:

That all students graduating from the Faculties of Education of Alberta's Universities after July, 1986, be required to have completed a computer literacy course.

Recommendation #4:

That the Board of Teacher Education and Certification prescribe the successful completion of a one semester computer literacy course as one of the prerequisites for graduation from an undergraduate program in a Faculty of Education in Alberta.

Recommendation #5:

That the Board of Teacher Education and Certification establish the successful completion of a standard, 40 hour computer literacy course as a requirement for the certification of teachers coming into Alberta.

Recommendation #6:

That the Faculties of Education in Alberta's universities offer major and minor specializations in educational computing.

2. Graduate Training

Recommendation #7:

That graduate programs in educational computing be offered by the Faculties of Education in Alberta Universities.

Recommendation #8:

That Alberta Education provide financial incentives to enable practising teachers to undertake graduate training in educational computing.

3. Inservice

Recommendation #9:

That an inservice program be developed and funded by Alberta Education, local jurisdictions, and the teaching profession to offer every practising teacher and educational administrator in Alberta the opportunity to learn the fundamentals of educational computing. Further, that implementation of an inservice program begin before the end of the 1983-84 school year.

4. Continuing Education

Recommendation #10:

That post secondary institutions and other agencies, such as further education councils, offer credit and non-credit courses in educational computing to teachers and interested members of the public.

C. COURSEWARE

1. Standards/Evaluation

Recommendation #11:

That Alberta Education continue and expand its work in courseware evaluation by further defining and disseminating content, instructional format, and technical design standards.

Recommendation #12:

That Alberta Education develop a capacity to evaluate educational software.

Recommendation #13:

That, where possible, Alberta Education cooperate with school jurisdictions, agencies and other provincial departments in the evaluation of courseware, and in establishing uniform standards for cataloguing and indexing, plus technical and pedagogical design.

Recommendation #14:

That all courseware be field tested by teachers and students in Alberta's schools, prior to being designated as "prescribed" or "recommended".

2. Clearinghouse/Distribution

Recommendation #15:

That Alberta Education continue to operate a central courseware clearinghouse and that all endorsed courseware meet Alberta Education's established standards.

Recommendation #16:

That buy-agreements continue to be made with the vendors of prescribed and recommended courseware and that this courseware be distributed, where practicable, through the School Book Branch of Alberta Education at the standard discount.

3. Development/Production

Recommendation #17:

That the Government of Alberta encourage the development of a courseware industry and that this encouragement be in the form of incentives, funding assistance, and shared research.

Recommendation #18:

That the Alberta Government introduce tax incentives that will encourage private investment in the courseware/software industry; further, that the Alberta Government encourage the Federal Government to introduce similar tax incentives.

Recommendation #19:

That the Government of Alberta encourage the Federal Government to address the issue of copyright of computer courseware/software.

Recommendation #20:

That the Government of Alberta provide national and international marketing assistance to Alberta courseware developers who are attempting to market their products elsewhere.

Recommendation #21:

That the Government of Alberta support the development of courseware in areas of special need; in particular, for gifted and talented and handicapped students.

Recommendation #22:

That quality courseware be sought to support the teaching of computer literacy; if not available, that it be immediately developed for use in Alberta.

Recommendation #23:

That Alberta Education utilize the services of ACCESS and other agencies, where possible, to co-acquire, reproduce, and distribute courseware/software.

D. HARDWARE

1. Evaluation and Acquisition

Recommendation #24:

That Alberta Education develop and establish standards for the acquisition of computer hardware according to proposed application and that these standards be reviewed annually.

Recommendation #25:

That Alberta Education negotiate selected, provincial buy-agreements with computer manufacturers who meet the established hardware standards, and that these buy-agreements be re-evaluated as hardware standards are reviewed.

Recommendation #26:

That school jurisdictions purchase computer hardware, where possible, from local dealers who will be responsible for distribution and service.

2. Distribution and Placement

Recommendation #27:

That there should be a minimum of one computer learning station for every eight students in a school.

Recommendation #28:

That for CAI and Business Education applications, one laboratory of computers for every 8 classrooms be established at the junior and senior high levels.

3. Networks

Recommendation #29:

That Alberta Education encourage the establishment of computer network systems and establish a central data bank to support these networks.

Recommendation #30:

That Alberta Education set network standards to enable school jurisdictions in the province to electronically communicate with each other and with centralized data bases.

4. Peripherals

Recommendation #31:

That Alberta Education encourage the development and introduction of computer peripherals that will enable all handicapped students, including physically handicapped, learning disabled, and developmentally delayed students to communicate with and use computers.

E. PLANNING

Recommendation #32:

That Alberta Education provide bold and decisive leadership in educational computing.

Recommendation #33:

That Alberta Education develop a comprehensive, strategic provincial plan for educational computing, which shall be reviewed at least once per year.

Recommendation #34:

That Alberta Advanced Education, in conjunction with Alberta's universities and Faculties of Education, develop a plan to implement those recommendations that have implications for teacher training, and that this planning be initiated as soon as possible.

Recommendation #35:

That each school jurisdiction in Alberta develop a multi-year plan for educational computing, to be reviewed and updated at least once per year.

Recommendation #36:

That each school jurisdiction appoint an individual to coordinate the development and implementation of its educational computing plan.

F. ORGANIZATION

Recommendation #37:

That Alberta Education establish an Educational Computing Branch within the Program Development Division of the Department.

Recommendation #38:

That Alberta Education create the position of Computer Consultant and assign at least one Computer Consultant to each of the Regional Offices of Alberta Education.

Recommendation #39:

That the Minister of Education consider establishing a Minister's Advisory Committee that would review directions, policies, programs, services, and other matters relating to educational computing.

Recommendation #40:

That advisory committees, reporting to the Director of Educational Computing, be established to provide advice on specific issues in educational computing and to keep the Director informed about developments within the province.

Recommendation #41:

That the Minister of Education encourage the establishment of a Committee consisting of senior representatives of government departments to assess the implications of high technology for the educational system, and for business and industry in the province.

Recommendation #42:

That the Minister periodically convene a public seminar to examine the social significance of technology and its implications to education.

G. FUNDING

Recommendation #43:

That the Government of Alberta establish an Alberta Heritage Foundation for Educational Computing to provide funding support for the recommendations of this report.

Recommendation #44:

That the Government of Alberta, through Alberta Education, provide the major portion of the funding and incentives to carry out the recommendations contained in this report.

Recommendation #45:

That the funding be provided in various forms, including earmarked grants, matching grants, and various incentives.

Recommendation #46:

That programs such as the Building Quality Restoration Program (BQRP) and the Educational Opportunities Fund (EOF) be continued, to provide financial assistance for hardware acquisition and educational computing projects.

Recommendation #47:

That model, 'high-tech' schools be established and jointly funded by Alberta Education and cooperating school jurisdictions.

Recommendation #48:

That Alberta Education establish a designated fund for the support of courseware development for students with special needs.

IV. RESEARCH AND IMPLICATIONS

A. RESEARCH

In the course of our discussions, we identified a number of issues that require further examination. Some fundamental questions arose which we could not answer; nor could others, as we deduced from a review of the published literature.

The issues we have identified need to be researched in a controlled, verifiable, and systematic manner. For certain purposes, the best means of investigation and assessment may be by demonstration and experimental projects, conducted perhaps in the 'model schools'. Careful efforts must be made to monitor these projects and evaluate the results of other educational computing activities. With the assistance of sound research, we can refine our approaches and enhance the benefits attained.

The issues we have identified include the following: the effects of computing on the learning process, the role of teachers, the organizational structure of schools, the mental and physical effects of computer use on students, and the implications of computers to social attitudes and relationships. The object of the research is to refine our understanding of specific matters so that we can make computers serve us better.

In due course, these questions must be addressed. The Director of Educational Computing, assisted by appropriate Advisory Committees, should decide research priorities and establish a long range research plan. Research studies should be tendered, according to practice, to interested individuals, school jurisdictions, universities, and consultants.

Research will require provincial government support. Recognizing the need for reliable research, we advise that this support be set at $1.5 million per year, on average, for each of the next five years; approximately 50% of this amount could be used to support the model schools described above.

The following issues require further research:

1. In Computer Assisted Instruction, how much time at a computer learning station is desirable for each student? What guidelines are advisable to assist teachers in designing instructional strategies that incorporate CAI? At specified achievement levels, in particular subjects of study, what is the ideal? Are there useful measures of optimal times at a computer learning station, and appropriate sequencing and presentation of instructional material (e.g., tutorial, drill and practice, simulation, etc.)?

2. Are any of the conventional computer programming languages more or less suitable than others for the instruction of programming? For example, the Alberta Education Computer Literacy Pilot Project is finding that many children in Grade Four have difficulty in learning BASIC because of a conceptual problems with the notion of variables. Are there inherent differences between computer languages, relative to their structure and other variables, that impinge on their ease of learning, adaptability, and utility? How does this affect decisions regarding the selection and purchase of hardware?

3. Is the congnitive development of children affected by learning how to program and use computers? Can the effects, if any, be measured in a meaningful way? Does the learning of algorithmic and heuristic processes enhance creativity and problem solving? At what ages, and to what degree can average school children benefit from learning computer programming?

4. How can we implement alternative approaches to develop skills by using computer technology? Can the departmentalization of subjects be reduced by alternate, intergrated approaches of delivering instruction?

   Which courseware designs are most effective in delivering instruction - specifically with reference to subject and achievement level? How can courseware be best designed to accommodate continuous student progress and effectively monitor individualized instruction?

5. What are the relevant ergonomic factors and what are the effects upon learning and the mental and physical wellbeing of the students and teachers? What practical measures can be taken to enable people to use equipment without discomfort or endangering their physical and mental health? What are the implications of prolonged exposure to video display terminals? In what way do ergonomic factors effect concentration, attention, and stress level of individuals?

6. Is there any relationship between age, gender, and computer use? What is the explanation for the reduction in interest in computing by girls as they advance to higher grades? Would equal use of computers affect the development of scientific and mathematic performance of girls as opposed to boys?

7. What are the most practical designs for the implementation of an interactive computer network? How can classrooms, schools, and administrative offices be effectively linked? What administrative functions can be best supported, in the short-term, by an interactive network? In its submission to the Task Force, the Edmonton Public School Board expressed strong interest in the potential of computer networks for administrative purposes.

8. What are the hardware requirements for classrooms, laboratories, and libraries? Given specific courses and student achievement levels, what are the ideal configurations, and ratios of students to computer learning stations. How can various types of hardware be effectively integrated into the learning process?

B. IMPLICATIONS

We draw a distinction between specific issues which require research and the broader implications of the widespread use of computers in schools. The implications are the social and structural consequences use of computers in schools. The following questions call for indepth assessment:

1. How will educational computing affect the role of teachers? Will the use of computers require teachers to modify the preparation and conduct of their instructional activities? Will the use of computers permit a significant increase in the amount of time available for individualization of instruction? Can use of computers alleviate some of the tension and stress that teachers experience? How will computers affect the attitudes of teachers?

2. What will be the impact of educational computing on the organization of classrooms and schools?

3. How will the use of computers affect the relationship between the home and the school? Will the locus of control of education shift dramatically to parents as more computers are acquired for home and personal use and quality courseware becomes available to the public? What are the implications of distance education? Will changes to the statutory provisions that relate to compulsory school attendance and home schooling be required to accommodate the delivery of education over a distance?

V. SUMMARY AND CONCLUSIONS

A. SUMMARY

We have a reasonably clear vision of the future that we foresee for educational computing in Alberta. We wish to have our children graduate from school prepared to function and contribute to their community. We want the province to be prosperous enough to offer meaningful career opportunities to our school graduates so that they need not move away in search of challenge and reward.

Our recommendations direct the province toward that future. Let us summarize them to clarify 'where we think the province should be' in five years time.

Within the next 5 years, we forsee the following:

1. all students graduating from Alberta schools will be computer literate
2. all teachers graduating from Faculties of Education of Alberta universities will be computer literate. All those interested in computing will have an opportunity to study the instructional use of computers, in depth, as a specialty at both the undergraduate and graduate levels.
3. each school district in Alberta will have a minimum of one trained teacher on staff as a computer specialist to provide guidance, technical assistance, and support in instructional computing. In larger jurisdictions, other positions will be in place in administration and planning.
4. teachers who wish to, will have access to a computer for administrative purposes.
5. all schools in the province will have some computer hardware, in most cases microcomputers. They will cost much less in comparison with today's prices. In general, we forsee a minimum of one computer station for every eight students.
6. quality courseware will be more readily available and a courseware distribution network will be in place.
7. Alberta will have a viable courseware/software industry producing material for use in the province and elsewhere.
8. a structure will be in place within Alberta Education to provide technical and advisory support to Alberta school jurisdictions. Working closely with teachers, administrators, and trustees, officials from Alberta Education will establish hardware standards, negotiate buy-agreements with manufacturers, evaluate courseware, assist in courseware development and provide leadership in planning for uses of computers in Alberta schools.

9. instructional, informational and administrative computer networks will proliferate, linking together teachers, classrooms, schools, school jurisdictions, regions, and provinces. Networks will enable educators to share information resources (e.g., such as test item banks).

10. computers will virtually replace standard typewriters in the classrooms and offices of the province. In response to employer requirements, business education classes will continue to move towards microcomputers and a mastery of word-processing skills.

11. there will be legislation in place protecting the confidentiality of individual student data stored on computer information/data bases.

B. CONCLUSIONS

In this report, reference has been made to the astonishing rate of technological development that appears destined to continue without hesitation. These developments are agents of change that confront all of us - our lives and the means by which we acquire a livelihood are being strongly transformed.

We, the members of the Task Force, have put forward the view in this report that the students in the province's schools, indeed that students everywhere, must have an opportunity to learn about high technology and, particularly, computers. This is hardly a revolutionary notion. The independent initiatives of teachers, strong support of parents (some of whom have purchased computers for home use), and decisions made in other provinces and countries support this view.

Students will need computer knowledge and skills to understand and manage the changes they will face. School graduates must be prepared to participate in a competitive work world pervaded by computers.

Prevailing trends indicate that a technological capacity is fundamental to the long term prospects of an economically diversified province. Future job opportunities and career challenges depend upon the acquisition of this capacity. Of course, this holds true for the county as a whole. A recent Science Council of Canada study stated: "In the quest for survival that is sweeping a very competitive world, economic policy has now become technology policy. Can Canada compete?" The Task Force suggests we must try to do so.

This discussion of educational computing has been guided by an abiding concern for the children of Alberta and their future. We have identified a pressing and urgent need to introduce computers into Alberta's schools. The recommendations contained in this report, if followed, will encourage and support this enterprise. We hope that these recommendations will form the basis of decisive action and urge that they be given serious consideration.

We hope that our efforts have been of assistance to the Minister of Education and to all Albertans.

VI. MEMBERS OF THE TASK FORCE

Gene Romaniuk, Chairman, representing Alberta's universities; is a Professor of Education and Associate Chairman of the Department of Educational Psychology, Faculty of Education, University of Alberta, Edmonton.

Jim Humphries, Deputy-Chairman, representing the post-secondary technical institutions and community colleges; is the Program Head of the Micro-computer Management Program, Grant MacEwan Community College, Edmonton.

George Bevan, representing Alberta Education; is the Director of the Curriculum Branch, Alberta Education, Edmonton.

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Alvin Gross, representing the Alberta School Trustees Association; is a member of the Board of Education, County of Barrhead, Barrhead.

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Max Lindstrand, representing the Alberta Teachers' Association; is Vice-Principal of Camrose Composite High School, Camrose.

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Jim Thiessen, representing Alberta Education; is the Director of the Computer Technology Project, Alberta Education, Edmonton.

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Alison Vaness, representing the Curriculum Policies Committee; is a school trustee with the Calgary Board of Education, Calgary.